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*Operations Analysis Department*

*Research Memorandum*

OAD RM 106

## LINCOLN SHELTER UTILIZATION STUDY

Volume II—A Shelter Assignment Procedure

*Prepared for:*

DEPARTMENT OF DEFENSE  
OFFICE OF CIVIL DEFENSE  
WASHINGTON, D.C.

CONTRACT OCS-OS-62-135



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MENLO PARK, CALIFORNIA

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By: Angelo Gualtieri Gordon F. Jensen

SRI Project No. IMU-4021

*Approved:*

G. S. WILEY, MANAGER  
OPERATIONS ANALYSIS DEPARTMENT

This is a working paper presenting the results of work in progress. The methodology, views, and/or conclusions contained herein are preliminary. Accordingly, this document does not constitute an official report of Stanford Research Institute, and therefore, may be expanded, modified or withdrawn at any time.

### OCD REVIEW NOTICE

This report has been reviewed in the Office of Civil Defense and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Office of Civil Defense.

## ABSTRACT

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This report is Vol. II of a report entitled LINCOLN SHELTER UTILIZATION STUDY. Vol. I is entitled "A Review of the Requirements of Shelter Utilization Planning." This second report deals specifically with a step-by-step process of assigning the population of Lincoln, Nebraska to fallout shelters. The techniques developed herein can readily be applied to numerous cities having characteristics similar to those of Lincoln, Nebraska.

This report describes a method by which large census tract maps can be designed and used in assigning blocks of people to shelters. The report further describes methods of developing day and nighttime population data for any given city.

A technique of putting the shelter assignment on data-processing cards for information retrieval is discussed. Various examples are presented of methods of sorting punched cards into useful shelter assignment reports.

Considerable attention is given to demonstrating the numbers of people who would be sheltered under three separate warning times. Certain rules, based on the natural behavior of people, are developed as an aid in the assignment process.

Estimates of cost and effort expended are provided as a guide to any CD official who would desire to use the techniques described herein.

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This report was prepared under the guidance and administration of Mr. Rogers S. Cannell, Director of SRI's Operations Planning Research Center. Rear Admiral A. G. Cook (Ret.), USN, who recently retired as Director, Disaster Council and Corps, City and County of San Francisco, acted as a general consultant.

## I INTRODUCTION

The assignment of people to shelter is one of the more difficult tasks in the shelter program. In cities lacking sufficient shelter spaces to accommodate the whole population, the problem of deciding who shall be assigned and who shall not, can become formidable.

In order to be able to accept the principle of an orderly assignment of those in the population who can be sheltered and frankly informing those who cannot, it is necessary to imagine the situation that would probably develop if no such provisions were made.

The public appears to be only partly informed as to the shelter situation. There is general awareness of the presence of shelter in most areas and there is some knowledge that supplies are being put into shelters. The result is an apathetic and somewhat complacent attitude that shelter has been provided, and if disaster strikes, shelter will be available.

In this situation public recognition of a sudden real emergency might touch off a wild scramble for safety which by itself would leave a large portion of the citizenry out in the streets at a time when it was vital to their safety that they be under cover. Furthermore, the insufficient shelter now available could cause actions that could lead to a large increase in casualties, both inside and outside the shelters. Such casualties would develop out of attempts to overcrowd shelters and would occur as groups of panic stricken people ran from shelter to shelter trying to find space.

An orderly assignment program which puts the appropriate number of people into the available shelters, and dissuades those remaining from leaving their localities, but arranges for them to provide for themselves, would seem to be the most practical at the present time. Those assigned would have some confidence that their move to shelter would be

the best action to take, and those not assigned would understand in advance the position and, according to their beliefs, could prepare as they saw fit.

In the following assignment program the aim has been to arrive as closely as possible to a practical situation as stated above. Many considerations have been studied; often decisions have had to be taken between conflicting requirements. Alternatives have been weighed and are included herein if it appears that different localities and situations could require them.

## II CONCLUSIONS AND RESULTS

As long as there is a shortage of shelters in most of the cities, towns, and communities in the United States, a program of assigning a part of the population to the available shelters presents severe difficulties.

In the work covered by this report, an effort has been made to find the best compromise available today.

It has been found necessary to draw a distinction between those who can be accommodated in the existing shelters and those who cannot, whether due to shortage of actual shelters, or distance of the people from the shelter. It is recommended that people who cannot be accommodated in shelters be so advised, and whatever assistance that can be given to them to provide for themselves should be given. The assignment process developed clearly identifies areas where no assignment is possible.

The assignment can be done in such a way that it conforms closely to the people's natural behavior, and by the application of certain rules, it is considered that assignment need not be dependent upon everyone knowing what their assignment is. Strangers to the locality and those who ignored the assignment information, could, in the emergency, still find their way to shelter.

It has been determined that two assignments are necessary, covering the substantially different distribution of the population by day and by night. However, the requirement for people to be cognizant of their assignment applies only to them while they are at home. When people are away from home the assignment depends upon their location, and provisions are included for informing them or leading them to shelter wherever they may be.

The assignment is designed to create population movements towards a center or centers of shelters, and thereafter to follow as closely as

possible the natural action people would take. This is to minimize the public indoctrination required to put this program into effect.

The assignment process takes into account the time taken for people to get into shelter. It is for local decision to determine, based upon targeting theory concerning that locality, how much warning time is most likely; then to apply the resulting warning time to the assignment, based upon a 3-mile-per-hour rate of movement of the people.

In the case of Lincoln, Nebraska, used as illustration in this report, three warning times were used to show the effect. Table I summarizes the numbers of people assigned to shelter under the various warning times.

Table I

COMPARISON OF ASSIGNMENTS FOR THREE WARNING TIMES--  
NIGHTTIME ASSIGNMENT--  
LINCOLN, NEBRASKA

Population and Shelter Categories		Warning Time		
		Ample	60 Minutes	30 Minutes
Population	Total	128,521	128,521	128,521
	Assigned	120,328	91,816	51,915
	Unassigned	8,193	36,705	76,606
Shelter Spaces (Categories 2-8)	Total	122,850	122,850	122,850
	Assigned	120,328	91,816	51,915
	Unassigned	3,222	31,347	71,225
	Overassigned	700	313	290

A detailed illustrated method of doing the assignment is included in this report.

The assignment process developed herein depends upon an accurate assessment of the population by day and by night. The methods used for determining this distribution are developed in the report. However, population distributions are not static, and with new building, and the



growth of the population, it becomes necessary to update the population data at regular intervals, such as annually. In putting the program into effect, an updating procedure should be budgeted for at the same time. As time passes, more shelter will become available and the assignment should be redistributed accordingly.

### III RECOMMENDATIONS FOR FUTURE PROGRAM

In an assignment task of this type, the substantial effort required places a large burden of responsibility upon the personnel doing the assignment, the possibility of doing the assignment centrally by computers would be attractive if it could be done effectively.

Such assignments would have the advantage of uniformity in the method, and would place less burden on the local CD officials.

Some thoughts on how such assignments by computer could be done are presented here, drawn from the experience gained in doing these assignments manually.

Ideally, the results from a computer assignment should be almost the same as the results of a manual assignment done by a thoroughly competent assigner.

The method would be to start from the census records, and produce a map of blocks and population. The map would then be covered by a grid which would enable conversion of the block location into grid coordinates. The block populations and corresponding grid coordinates could be transferred to computer tape. The shelters would be treated the same way. The center or centers of shelter would be found by an examination of the map. This could be computed, but in many cases it could be done by inspection, and its coordinates determined. The computer would then be programmed to assign blocks and shelters always working in the direction towards the center of shelter.

Assignment would start with the shelters farthest away from the center and work in towards the center.

The coordinate location system permits measurement of distance, and this would also be listed beside assignments.

Depending upon the city or community being assigned, the computer could be programmed to assign all shelters to capacity, or to limit

assignment to encompass areas of limited distance away from shelter, depending upon the predicted probable warning time for that area.

Several special effects would need development, such as programming to account for existing natural barriers and to avoid making people cross them.

It is considered that a workable program could be developed to remove the needs for manual assignment.

#### IV THE ASSIGNMENT PROCESS

In making an assessment of the process by which people can be assigned to shelter, a major consideration has been to evaluate the natural course of action people would take, and to fit the plan to suit this. The aim is thus to reduce the amount of public indoctrination needed to make the program work. An example of this is to arrange for people to travel in the same direction to shelter, and to avoid crossing paths. A person not knowing the plan, but in an assigned area, would tend to be naturally carried along in the main stream and to get to the assigned shelter by following the crowd. Even if only 50 percent of the population in assigned areas knew the plan, it seems reasonable to suggest that, by the methods described below, all the population would get into its assigned shelters.

##### A. Selection of Assignment Personnel

It is important to determine who shall make the actual assignments. In making this decision, there is a choice between the person very familiar with an area, who would avoid mistakes such as directing people to cross impassable barriers (e.g., high fences), but at the same time knows many people and becomes involved in deciding who shall have shelter and who shall not; and the person who is totally unfamiliar with anyone who lives in the area, and can assign in a dispassionate manner guided only by the rules.

The emotional response of a number of persons to the concept of assignment to shelter with its attendant responsibilities has been observed, and it is considered that assignment will be accepted more readily by local authorities if the work is done by a competent outside consultant acting in concert with the local civil defense director.

A step-by-step description follows of the actual assignment process that was developed using Lincoln, Nebraska as the model. Certain minor variations might be found desirable in other localities, depending upon

how the Architect-Engineer firm that did the shelter survey presented their results. It is intended, though, that the assignment method and the presentation of results shall be applicable to all communities regardless of size, except that small communities of about 10,000 or less would not need the services of the data-processing equipment discussed in this report.

#### B. Assignment by Area

The principle that is used is to assign people by areas. This means that assignment is not done by name, but by the occupants of an area, whether they be resident, at place of work or transient, visiting, or shopping. The smallest unit of area considered in Lincoln was the city block, which averages 400 feet square (about 3.7 acres), bounded by streets. Using this principle, it becomes necessary to determine as closely as possible the number of people that will be occupying a block at any time. For convenience, two periods were chosen: day and night. Day consists of the period from 7:30 AM to 5:30 PM, and night is the rest of the 24 hour period.

The determination of the distribution of the population at night was done using the census report HC(3) Number 236, "Housing" 1960. This gives nighttime population by blocks.

For daytime population distribution a computation was necessary and is described in Sec. V.

#### C. Preparation of Assignment Maps

Special maps were prepared in order to carry out the process of assignment. In order to prepare these maps the following steps were taken.

It was found that the A & E report for Lincoln included 8-inch-to-the-mile maps, divided into groups of tracts on 24-by-28-inch sheets. These were used as the basis for drawing the working assignment maps.

A typical map is shown in Fig. 1.

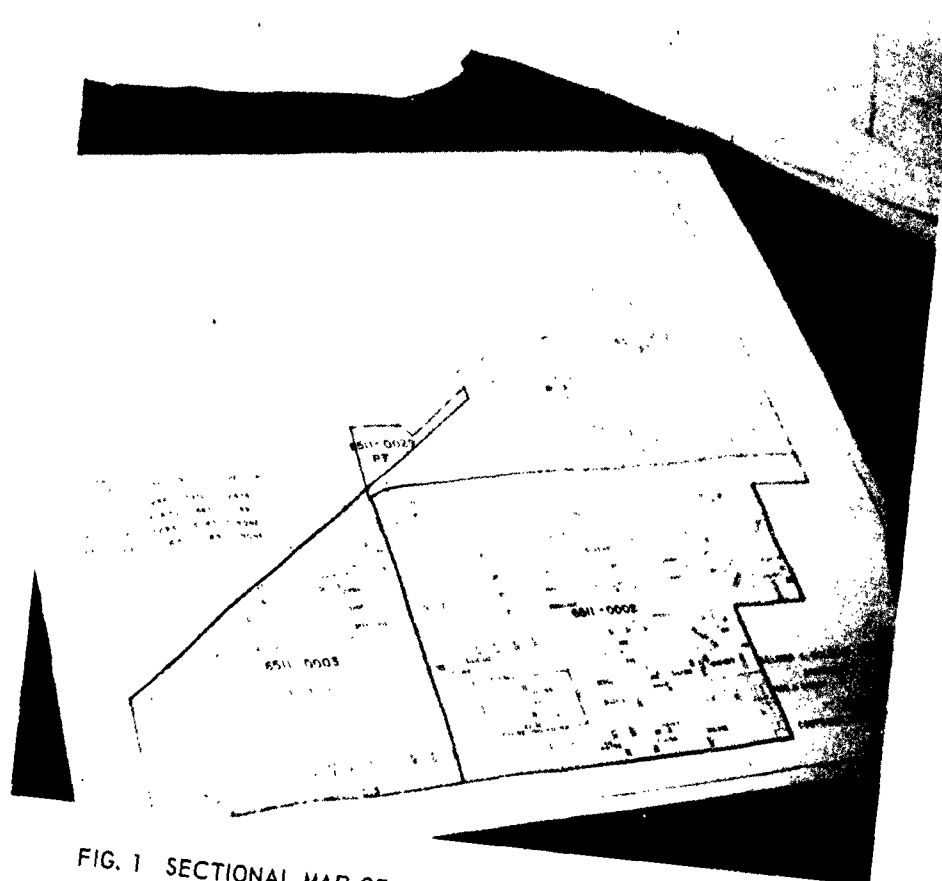


FIG. 1 SECTIONAL MAP OF LINCOLN SHOWING CENSUS TRACTS

The first step was to lay a sheet of tracing paper on the map (Fig. 2).

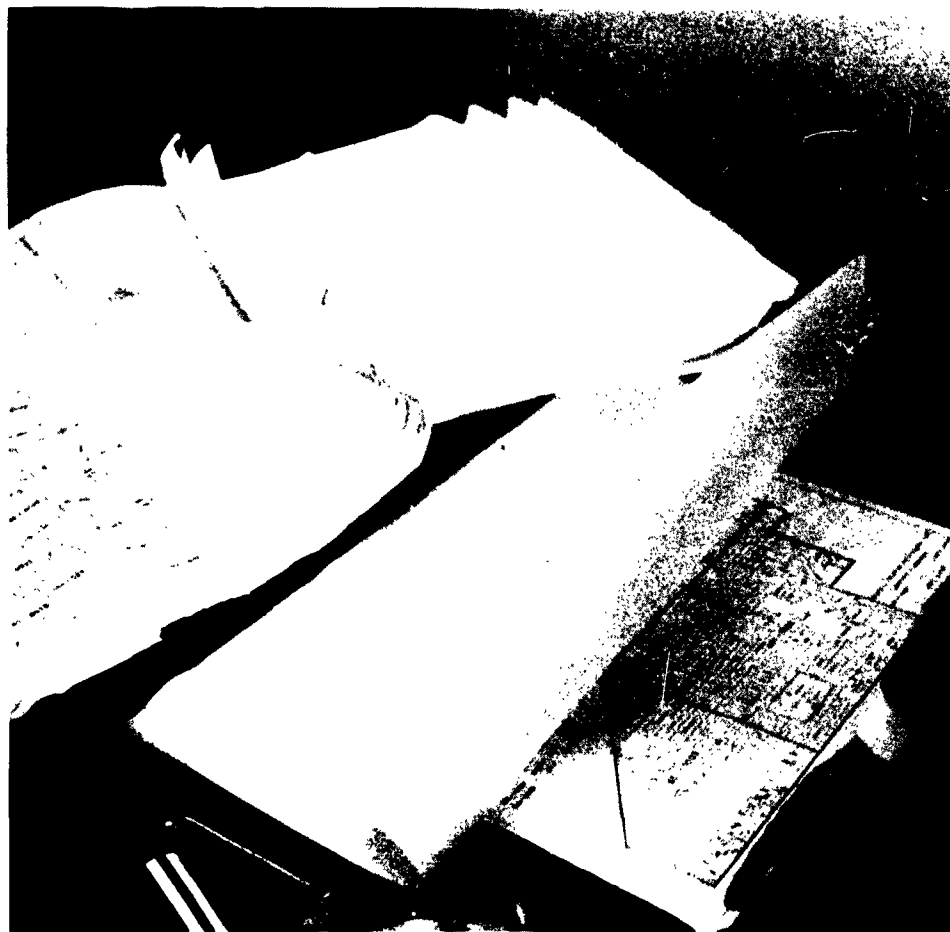


FIG. 2 PREPARING THE OVERLAY

Next, the tracts (Fig. 3), and blocks (Fig. 4) were outlined. The census tract data map which gives the block location (Fig. 5) was used for this. The blocks are numbered in the top left-hand corner of each block.

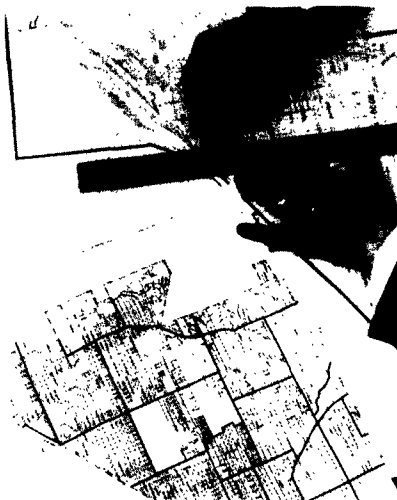


FIG. 3 DRAWING THE CENSUS TRACT BOUNDARIES

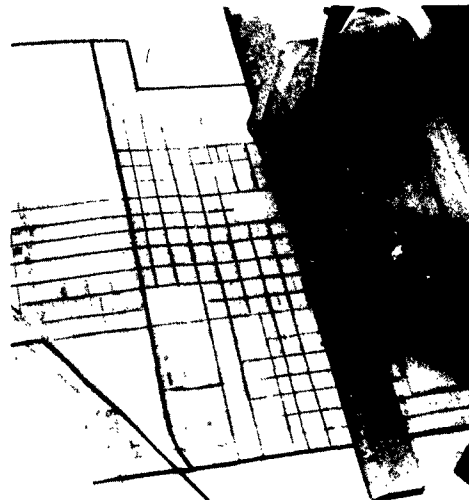


FIG. 4 DRAWING THE CENSUS BLOCK BOUNDARIES

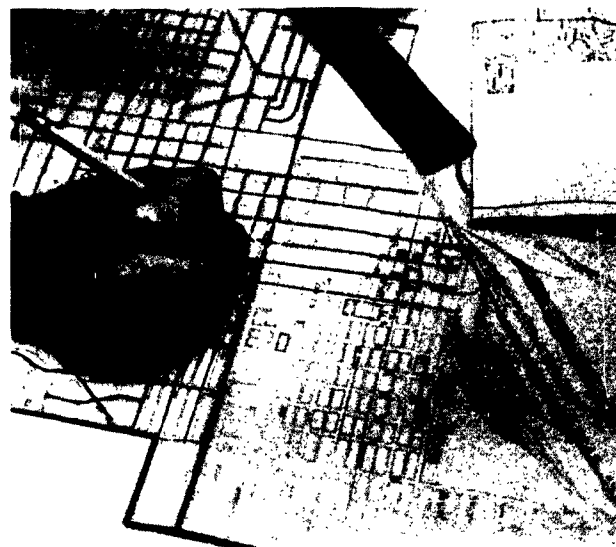


FIG. 5 ENTERING THE BLOCK NUMBERS



Next, the "Housing" census report HC(3) No. 236 was used. The block population was filled in as shown in Fig. 6.

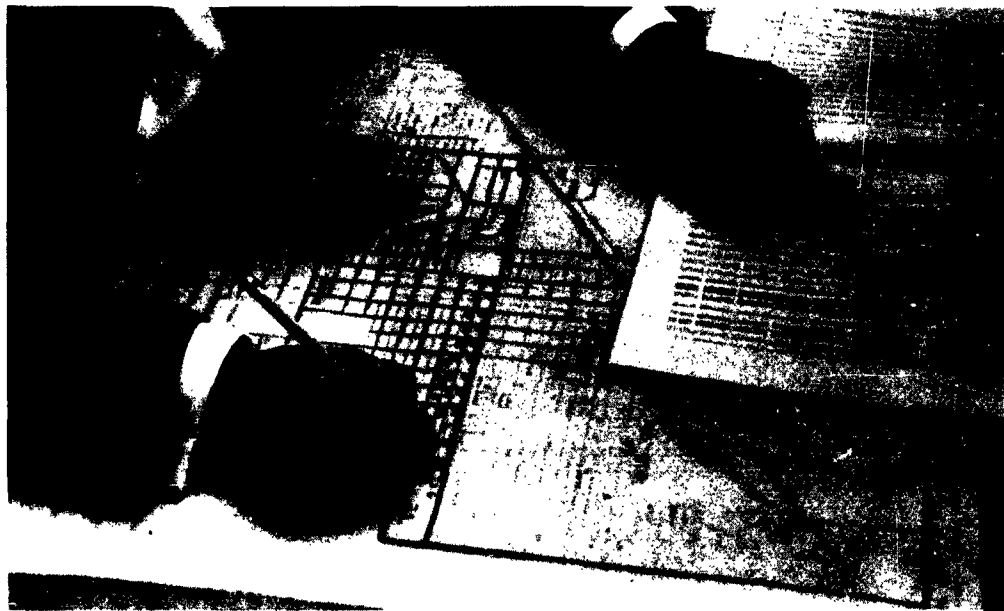


FIG. 6 ENTERING THE BLOCK POPULATIONS

In order to distinguish population figures from block numbers, the population figures were always underlined (Fig. 7).

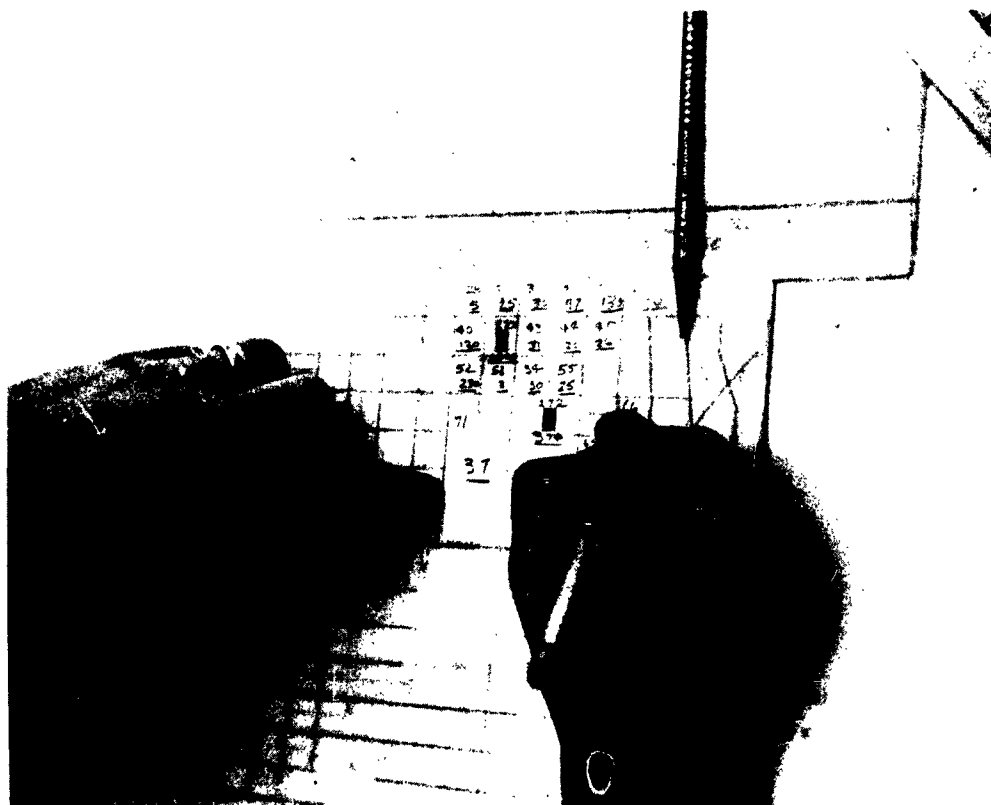


FIG. 7 METHOD OF DENOTING BLOCK POPULATIONS

Next, the shelters were entered. They are listed in the shelter survey Phase II reports provided by the Corps of Engineers. In Lincoln the Category 4 to 8 protection factor shelters were listed in a separate report from the Category 2 and 3 protection factors. It is important to note that the same shelter (facility) number often appears in each report, indicating shelters of Category 4 and Categories 2 and 3 in the same building. These are treated as separate shelters for assignment.

For easy reference and to avoid errors, the Category 4 to 8 list was duplicated black on white and the Category 2 and 3 in white on black (Fig. 8).



FIG. 8 SHELTER DATA AS FURNISHED BY THE FEDERAL GOVERNMENT

The shelters were entered on the map using the following procedure. The shelter was represented by a rectangle or square, and the facility number was entered above it. The capacity was written under the shelter and underlined. Category 4 to 8 shelters were marked by coloring the rectangle red, and Category 2 and 3, yellow. In the case of a shelter with both Category 4 and Category 2 and 3 shelters, the rectangle was divided, color coded, and the capacities written side by side underneath. The red or Category 4 part was always on the left (Fig. 9).

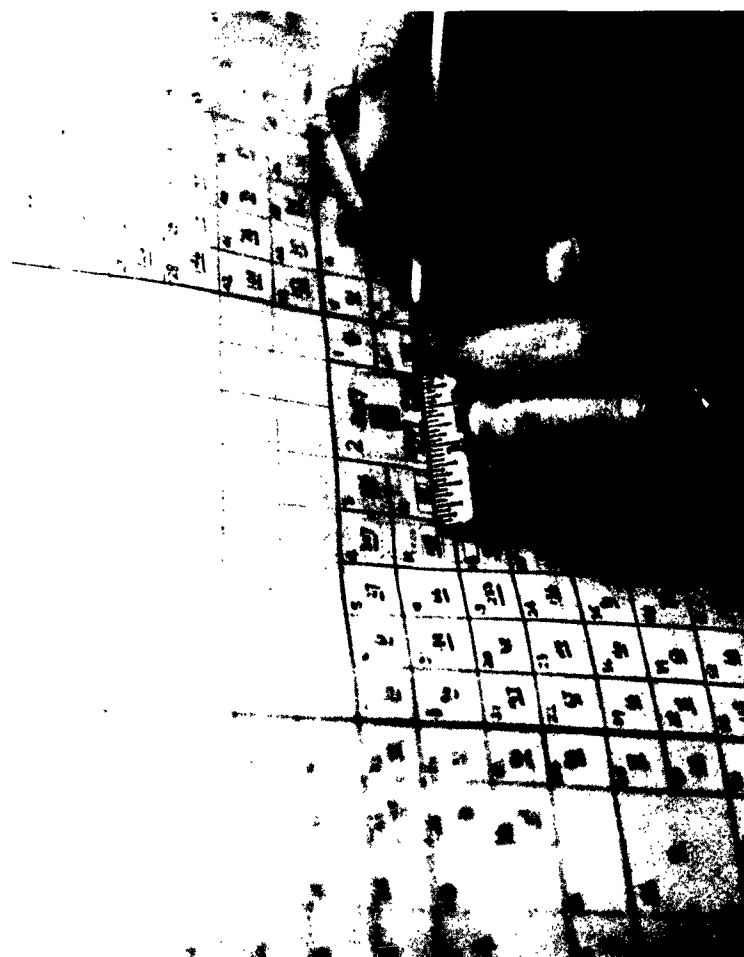


FIG. 9 ENTERING THE SHELTER DATA

The sections of the city were next cut out and Scotch taped together (Fig. 10), and the composite map set up on the wall (Fig. 11).



FIG. 10 ASSEMBLING THE COMPLETE MAP FROM SECTIONAL PIECES

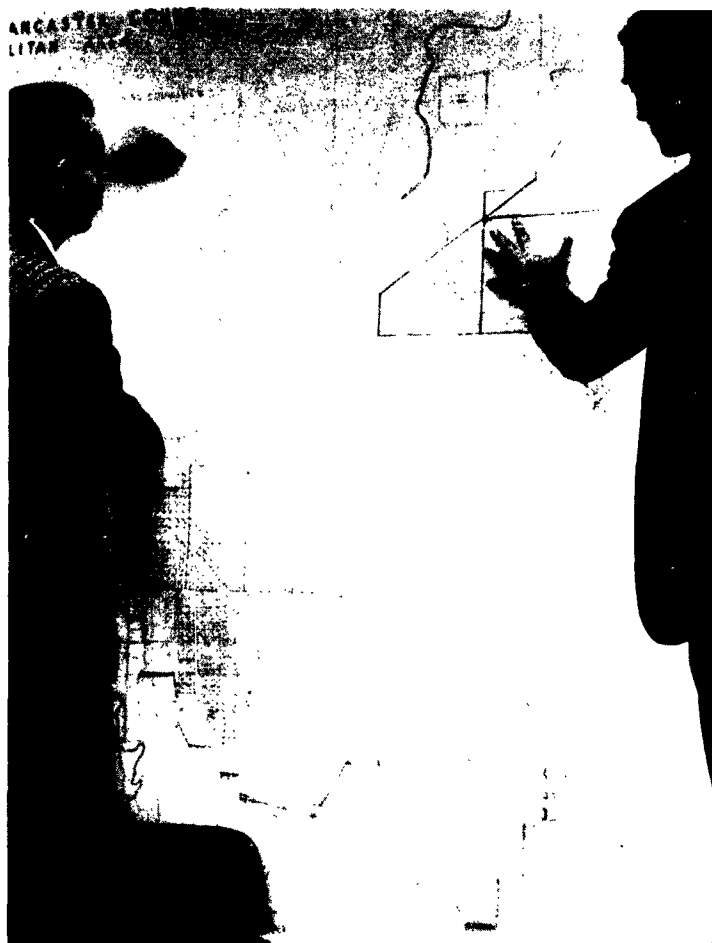


FIG. 11 MOUNTING THE MAP FOR ASSIGNMENT

NOTE: In the photograph the composite map is shown mounted on a large-scale 8-inch-to-the-mile map. This is not essential but it is important that the composite map be mounted over a white surface, otherwise the figures may be hard to see (Fig. 11).

In the downtown area (Tract 19) it was impractical, due to the large numbers of shelters, to use a map of the same scale as the rest of the city.

The Architect-Engineers had prepared a larger-scale map for this one tract and this was used (Fig. 12), and the data entered in a similar fashion (Figs. 13 and 14).

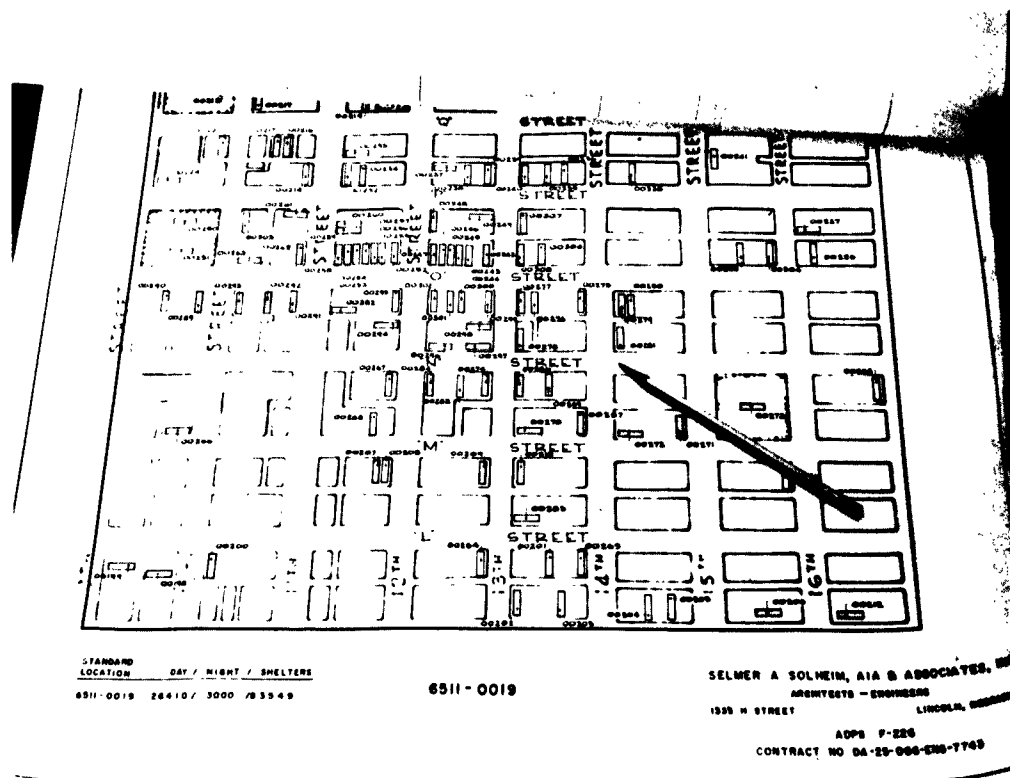


FIG. 12 LARGE SCALE MAP OF THE CENTRAL BUSINESS DISTRICT

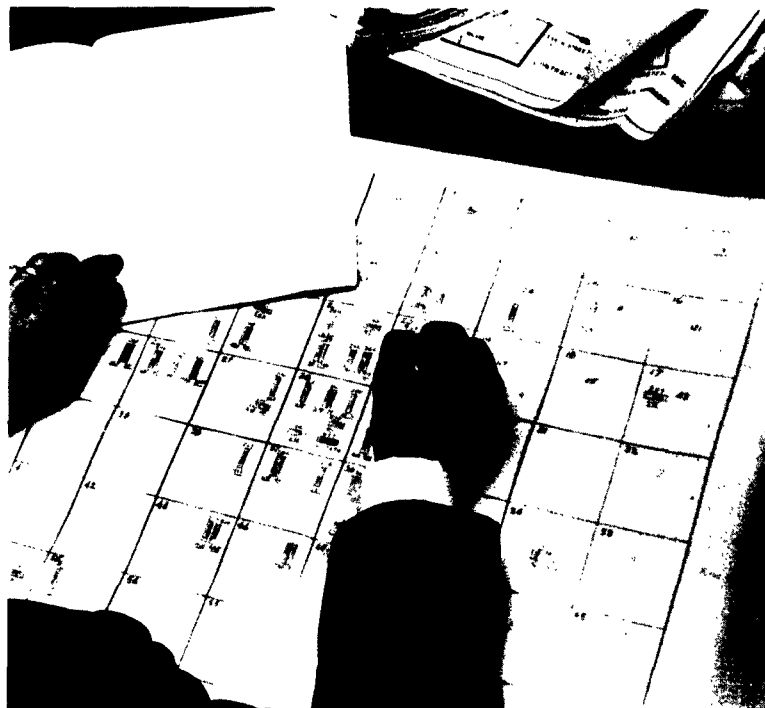


FIG. 13 ENTERING BLOCK POPULATIONS IN THE CENTRAL BUSINESS DISTRICT MAP

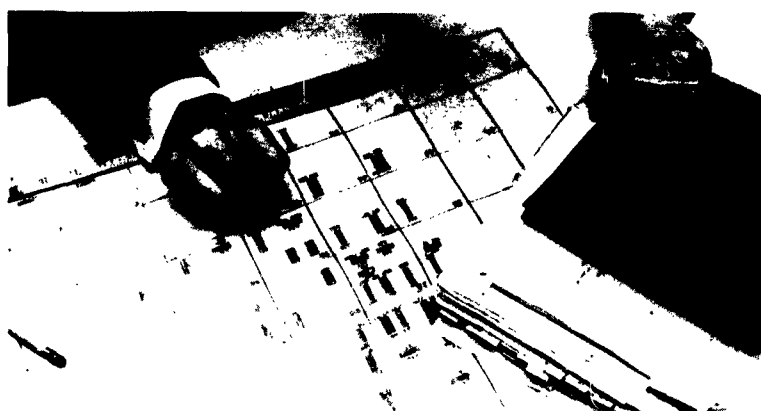


FIG. 14 ENTERING SHELTERS IN THE CENTRAL BUSINESS DISTRICT MAP



Block 23 in Tract 19 has a nighttime population of 63 people  
(Fig. 15).

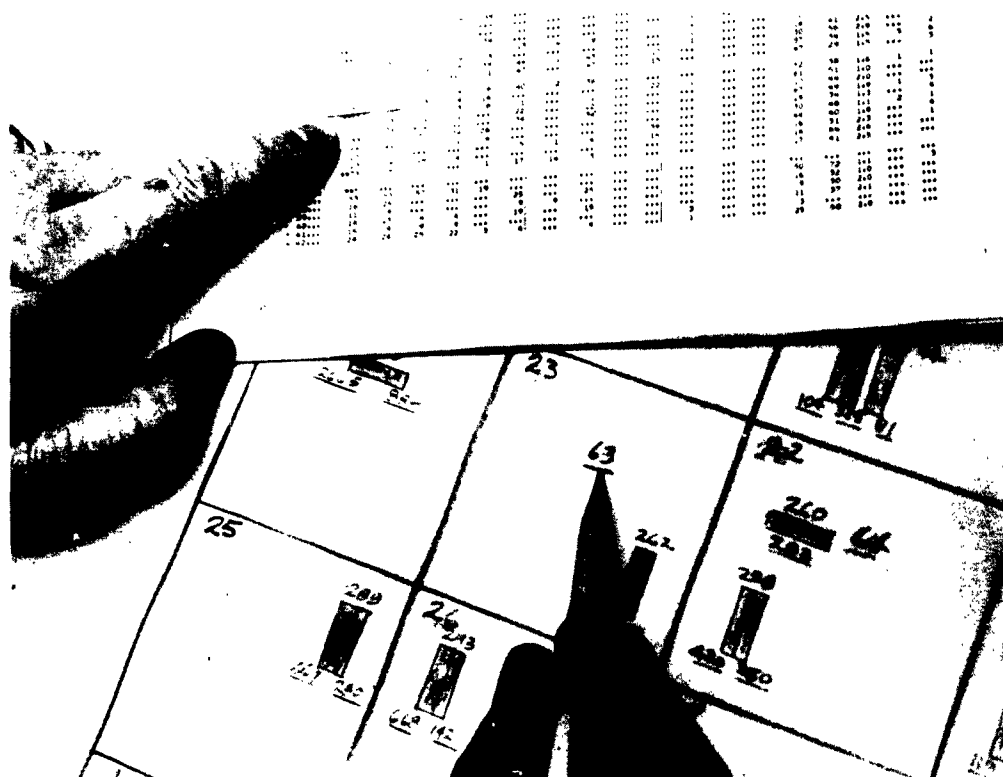


FIG. 15 DATA SOURCE DEMONSTRATION

The large-scale downtown area map was mounted beside the city composite map for ready reference (Fig. 16).

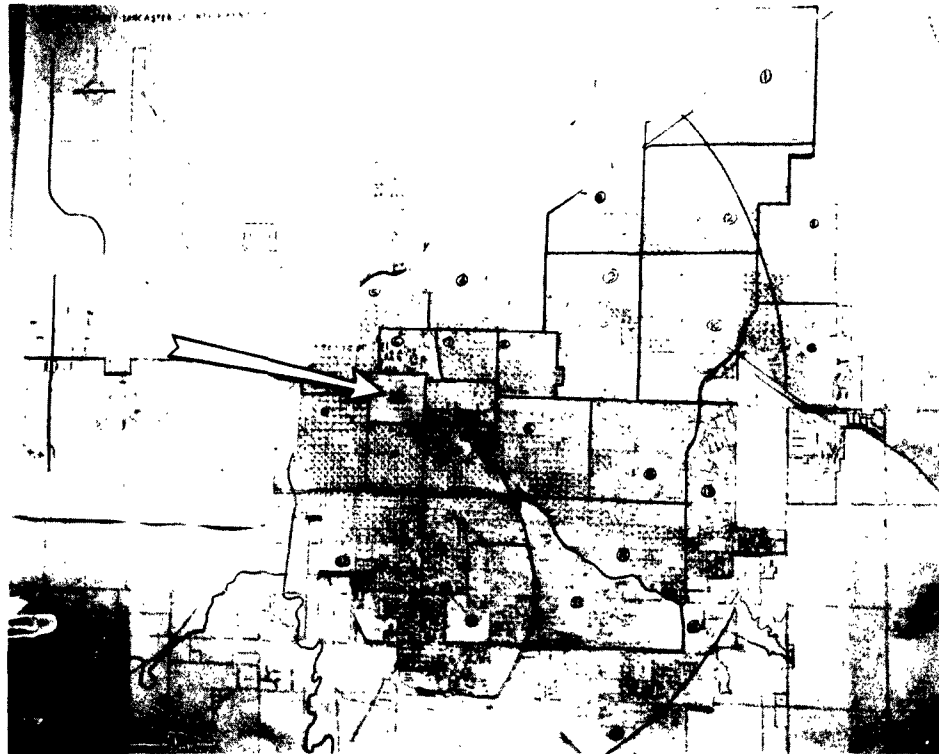


FIG. 16 SEPARATE ASSIGNMENT MAP SHOWING RELATIONSHIP OF  
CENTRAL BUSINESS DISTRICT

#### D. Method of Assignment

The complete assignment process was done three times for the city of Lincoln. During each assignment many lessons were learned and the knowledge gained was tried out in a subsequent assignment.

The results of this work have given rise to a preferred method, including some alternatives, which is described below.

An inspection of the map indicated that most of the shelters were concentrated in a central area that covered one tract (19). Consequently it was easy to establish radial movement patterns of the population to the center of shelter. Once this was established, then the population was assigned so that everyone would move toward this center. This then is the first rule:

Rule 1--Establish a center or centers of shelters and arrange population movement only in the direction of center of shelter.

In Lincoln there is only one major center of shelter. In other cities there might well be two or more.

The objective here is to create a situation where definite streams of population movement are established that will carry along those who do not know or have forgotten their assignment. Since the assignment is designed to accommodate all the occupants of a block at any time, if enough people on a block know where to go they will take with them by "the following-the-crowd effect" those who do not know.

The next task is to establish zones or sectors in the city with boundaries that are not to be crossed by anyone going to shelter. Each zone or sector is to contain enough shelter for the occupants of the zone.

The division into zones will vary from city to city, and for small cities this step may not even be necessary.

In Lincoln it was found convenient to divide the city into four quadrants by using two very well known streets as the dividing lines.

If the dividing lines are well known, public indoctrination becomes much easier, since it is easy to inform people that to reach their assignment regardless of where they are they must "go toward the center of town," and "not cross 'O' street or 10th street." In Lincoln, these are the two streets which are the dividing lines, both of which are very well known (Fig. 17).

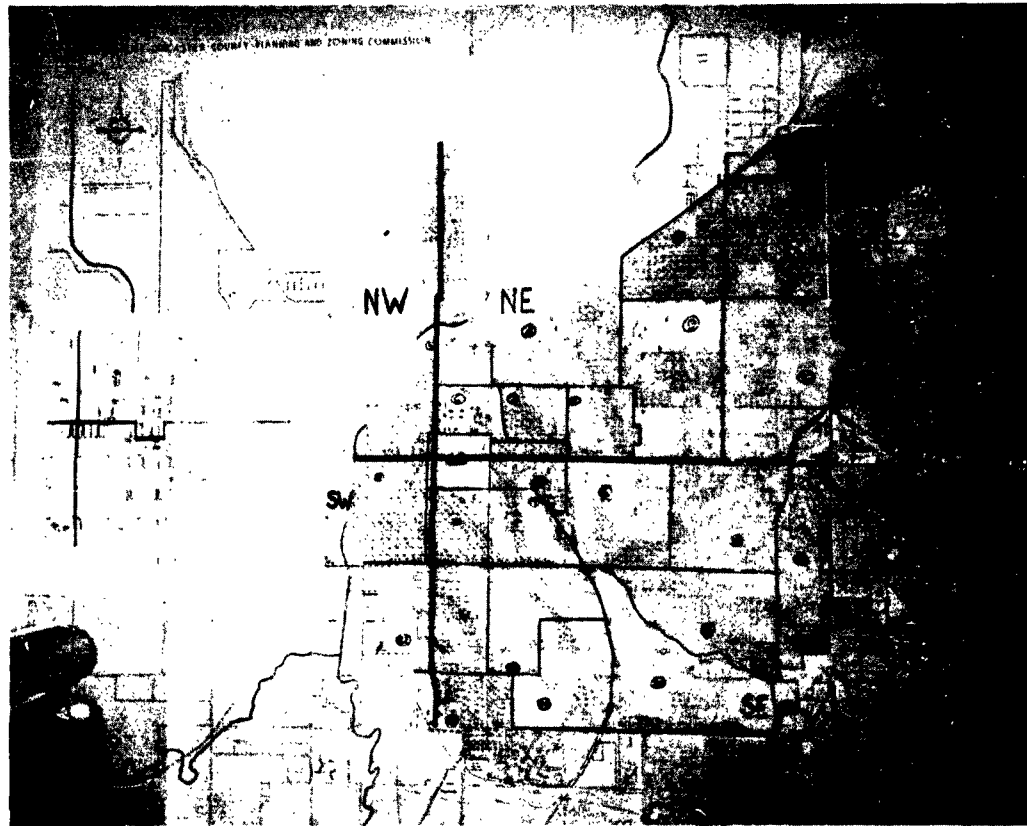


FIG. 17 QUADRANT DIVISIONS TO FACILITATE ASSIGNMENT

Before these dividing lines can be set it is necessary to make some trial computations to ensure that each sector or quadrant does contain sufficient shelter for the population of that quadrant. This must be checked for both day and night population distribution, and to establish the boundaries some judgment is necessary. In Lincoln, where there is insufficient shelter, it was decided that those areas which could not be assigned should logically be those areas farthest away from the shelters, since those people would be the least likely to reach them in time. These areas turned out to be in the northeast and southwest quadrants.

Due to the concentration of shelter in the downtown area it was certain that the dividing lines should cross or meet in the downtown area.

The boundaries were arbitrarily set using a north-south street, and an east-west street, and the shelter and population in each quadrant added up. It was found that there was a surplus of shelter in one quadrant and an unnecessary shortage in the other. The boundaries were then shifted to equalize the situation, and the population-shelter relationship was rechecked. When a satisfactory relationship was reached, the boundaries were fixed.

An inspection of the map (Fig 17) shows that if the population converges on the downtown area and stays within its own quadrant, the streams of people are naturally guided into their correct shelter area, and the problem of direction into a specific shelter is made easier. It will be shown later how specific assignment will be arranged so that people will fill the shelters in their natural order of arrival, thereby promoting an orderly procedure.

Even if the local Civil Defense authority decided not to make specific assignments, the division of the city into quadrants and public information about this would substantially ease the situation of people finding shelter at random.

Rule 2--Divide the city into sectors or quadrants which are designed so that:

- (a) Each sector or quadrant will contain shelter for the population that is to be sheltered within a specific quadrant.
- (b) The dividing lines would be well known streets or natural boundaries that would best facilitate communication to the population.

A separate assignment is to be done for both the night and daytime distribution of the population. Much consideration has been given to trying to arrange for a single assignment regardless of time of day.

The nighttime assignment places families together in shelters in the business district. Maintaining the same assignment during the day, the head of the family is already working near his assignment and proceeds to it, and his family would join him there. This would be an attractive idea if it could be made to work.

Unfortunately, there are too many variations from this ideal and severe difficulties are introduced in trying to carry it out.

The division of the city into quadrants for easier population control would have to be abandoned, since there is no assurance that people work in the same quadrant as they live. The quadrant technique is considered a vital element in the orderly passage of people and children, especially insofar as it assists people to find their proper shelter.

A further difficulty would be the large amount of additional traffic in and out of buildings, generated while people change buildings to get to their assigned shelter. Many buildings do not have sufficient stairway or doorway space to permit this kind of traffic, and confusion would occur with people going in all directions within the business district. Thus, the concept of everyone moving in one direction toward the center of shelter also would have to be abandoned.

As a result of these considerations, two assignments are recommended.

The assignment should be done by two persons--one, the assignor, working at the map, selects the shelters and the blocks of people to be

assigned to each shelter; the other, the recorder, writes down the assignments as they are made and, using an adding machine, keeps a running total of the number of people as they are assigned (Fig. 18).



FIG. 18 THE ASSIGNMENT PROCESS

The method of recording shelter is shown in Fig. 19.

The two left-hand columns indicate tract (underlined), shelter number and the capacity of the shelter. In the left-hand margin the protection factor of the shelter is written in the appropriate color. (red for Category 4 and yellow for Categories 2 and 3).

The third through eighth columns are devoted to assignment of blocks. The third column shows the location of the tract from which the assignment is made, and the remaining columns record numbers in sets, such as "49-58." The first number, 49, is the block number, and the second number, 58, is the population in that block.

Occasionally, it becomes necessary to split a block between two shelters so as to avoid substantial over- or under-assignment of one of the shelters. In such a case, only the number of people allocated to that assignment is entered after the block number; also a (p) is drawn after the population to indicate partial assignment.

A partial assignment looks like this: 43-71 (p) (see Fig. 19).

Partial assignment should only be done when the parts of the block are assigned to the two parts of a single shelter facility (such as the Category 4 part and the Category 2 and 3 part), or to shelters that are very close to one another. This will facilitate people staying in groups and moving to shelter in the same direction.

The last two columns show totals. The last column is the total assigned to a shelter, and the next to last column shows the remaining unassigned spaces. If the shelter has been over-assigned by a few people a negative sign (-) is entered by the number. As a check, the sum of the totals equals the shelter capacity.

In selecting the shelters for assignment, there are more rules to be followed.

Rule 3--Assign shelters in the outlying areas and away from the central district first. Start in the fringe areas and work in toward the center of the shelters.





By the process determined by Rule 3, the assignment follows the trend of people going in one general direction and naturally filling shelter as they reach it. Those nearest can be expected to reach shelter first. People reaching a full shelter should continue toward the center until they find empty shelter. By following the rule the actual assignment would closely follow the natural situation.

Rule 4--Always assign first, the occupants of a block in which the shelter is situated. Then assign from the direction from which people will be coming.

Those in the same block as a shelter can be expected to know about and reach the shelter first, so it is logical to so assign them. After that (if there is room) people are taken from neighboring blocks from which they will be coming.

Rule 5--Assign blocks in groups to any one shelter so that those assigned to a shelter will find themselves leaving their homes, shops, offices, and work places as groups, and travel to shelter in groups.

This rule is to avoid confusion caused by people taking off in different directions. The aim is always to make the transfer to shelter as orderly as possible and provide for a proportion of the population who won't know what to do.

When all the shelters outside the central area have been assigned, the shelters in the central area can be assigned. Some of these are quite large, and will accommodate larger portions of the city. The rules for assignment remain the same.

In Lincoln the distance people would have to travel assumed importance at this stage, and it became necessary to measure this.

For the purpose of establishing distance limits several warning times were considered. These were:

- (1) Half an hour warning time
- (2) One hour warning time
- (3) Ample warning time.

In terms of distance to shelter a 3-mile-per-hour travel rate was assumed. This was represented by:

- (1) Up to 1-1/2 miles
- (2) Up to 3 miles
- (3) Over 3 miles.

Assignments were marked on the record sheet with a "1" in red for distance between 1-1/2 to 3 miles, and "11" in green for over 3 miles.

The measurement of the distance to travel was determined by one of two methods. The simplest was to use a piece of string with knots in it at appropriate points representing 1-1/2 miles and 3 miles from one end. It was found simplest to attach a thumbtack at the end and press that into the shelter. Then the string is held out over the area being assigned and indicates the direct distance from the shelter (Fig. 20).



FIG. 20 DIRECT DISTANCE MEASUREMENT

In the case of Lincoln where the streets are predominantly north and south and east and west people cannot follow a direct path, but must follow the streets. To meet this, a plastic isosceles right-angle triangle was made and used (Fig. 21).



FIG. 21 SPECIAL RIGHT SQUARE USED FOR DISTANCE MEASUREMENT

It will be seen that if the sides adjacent to the right angle are made the equivalent of 3 miles long, then the distance from any point on the hypotenuse to the tip of the right angle is always 3 miles, provided one travels in directions parallel to the sides adjacent to the right angle. The sketch in Fig. 22 illustrates this. Distance from A to O, via B, D, or E are all the same and equal to the distance OX.

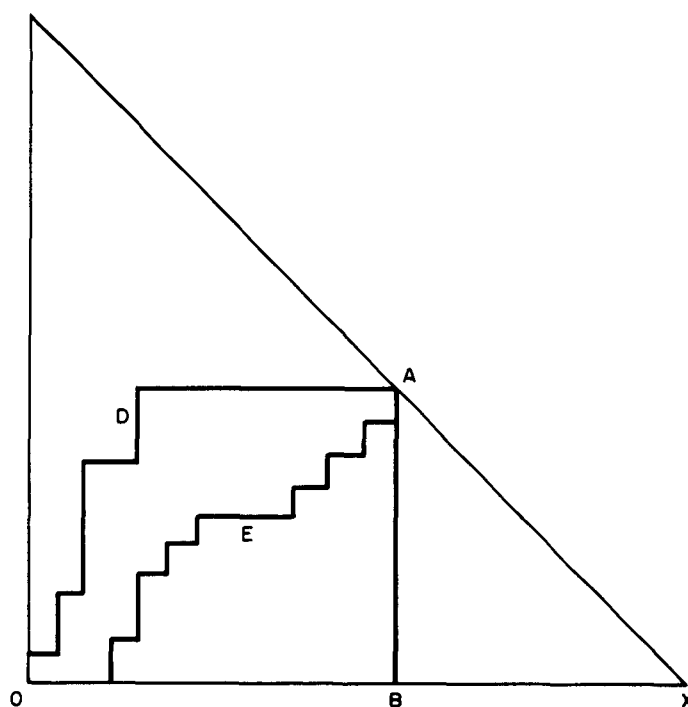


FIG. 22 APPLICATION OF COORDINATES TO DEMONSTRATE DISTANCE TO SHELTER

Undoubtedly there are a few diagonal streets that will permit a more direct approach for a few people but for the purpose intended this method is considered accurate enough to determine the distance people have to travel to reach shelter.

Referring to Fig. 21, the triangle used has an additional line scribed which divides the sides adjacent to the right angle. The scribed line encloses an area within 1-1/2 miles of the apex, and the whole triangle encloses an area within 3 miles of the apex (see Fig. 23).

The use of this 45° triangle is illustrated in Fig. 24. The assigner is pointing to a block that is outside the 1-1/2 mile area and within 3 miles from shelter.

Rule 6--In assigning shelters note the distance that each assigned block is from the shelter. If there are direct or nearly direct roads to the shelter area from the direction of assignment, use direct-distance measurement.

If the people must follow a street pattern that is north-south and east-west or similar, then use a 45° triangle to establish distance boundaries.

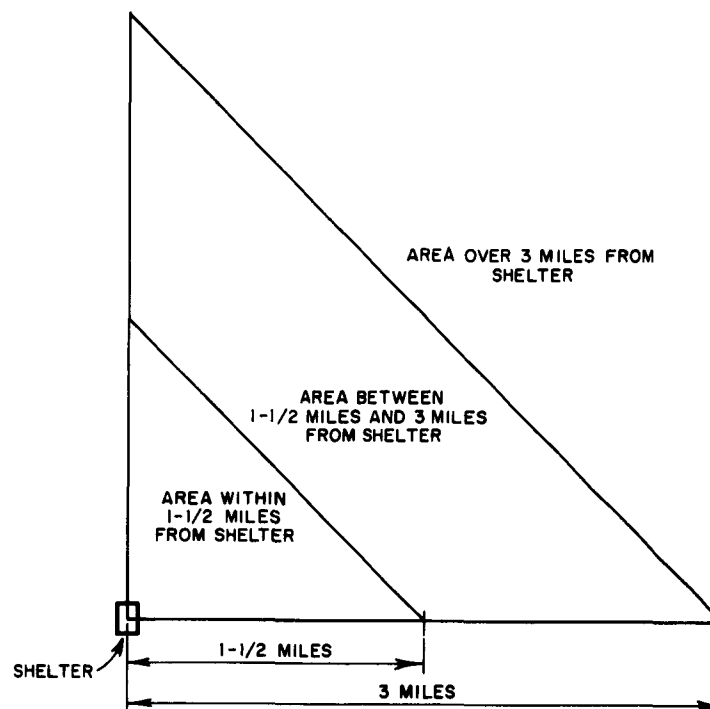


FIG. 23 AREAS ENCLOSED BY 1½ AND 3 MILE MEASUREMENT



FIG. 24 USE OF THE RIGHT SQUARE IN ASSIGNMENT

Upon completion of the assignment the map was colored and marked to show the distance of all assigned blocks from shelters. The blocks assigned and within 1-1/2 miles were left unmarked. Those in the area between 1-1/2 and 3 miles were shaded red and those outside 3 miles were shaded green. In addition, blocks that were within the assignment area, but had no population were shaded brown, and those unassigned in the outlying areas were shaded blue.

A convenient method of doing this is to use colored chalk as shown in Fig. 25.



FIG. 25 SHADING OF THE DISTANCE BOUNDARIES

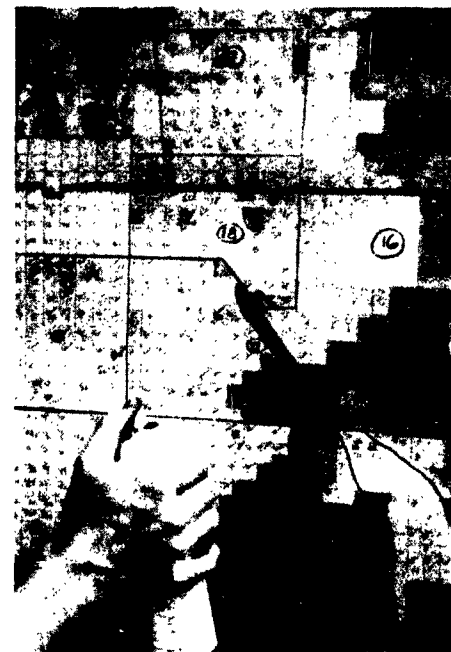


FIG. 26 SEALING THE CHALKED SURFACE

In order to avoid smearing, the chalk can then be covered with an adhesive fixative, such as hair spray\* (see Fig. 26).

The resulting map is shown in Fig. 27.

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\* A special product, KRYLON Workable FIXATIF N° 1306 is marketed especially for this process.



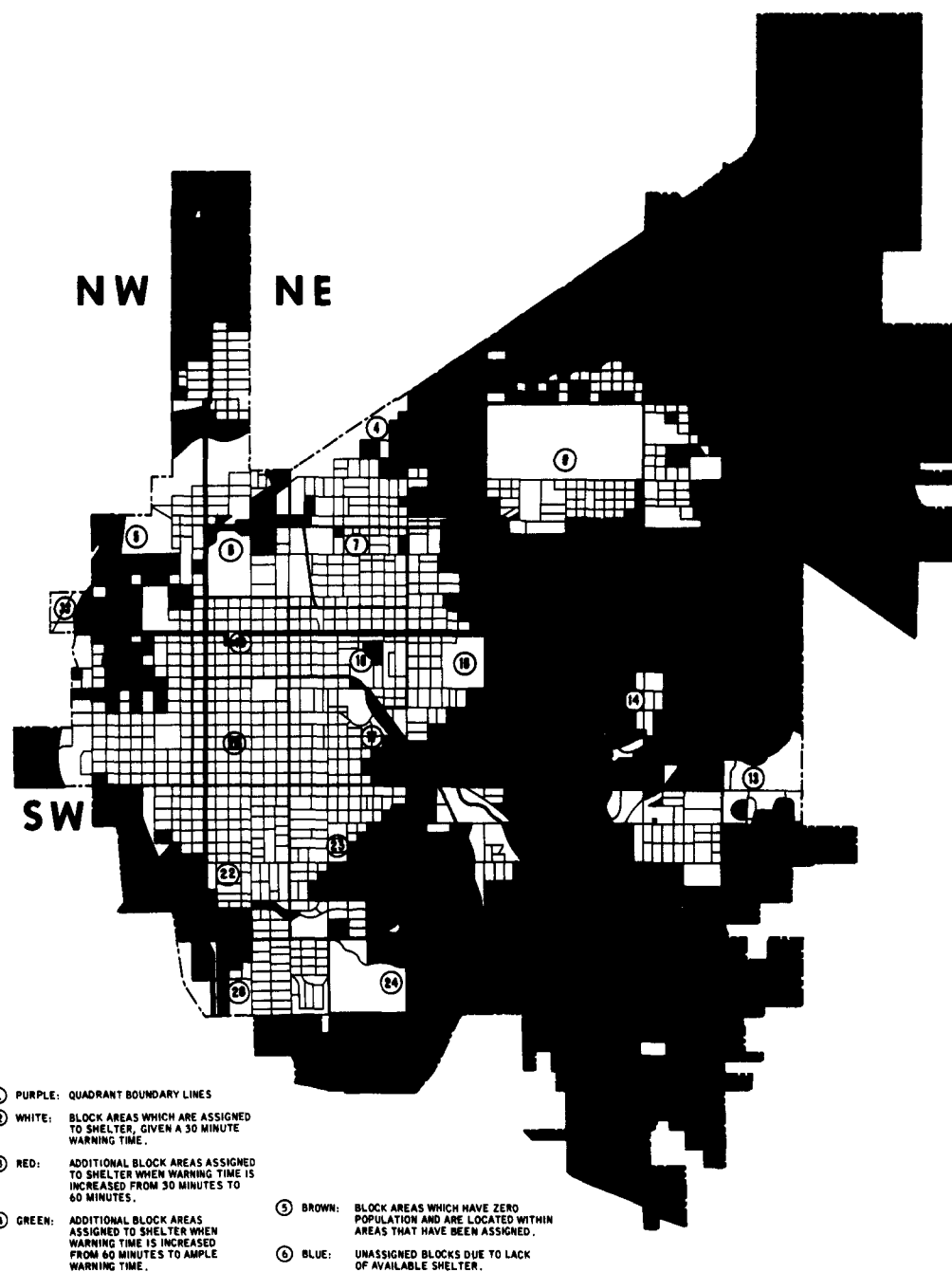


FIG. 27 THE COMPLETED ASSIGNMENT MAP

The boundary lines dividing the city into quadrants were marked with purple. It will be seen that there is a discontinuity in the east-west boundary in the central business district. It was found necessary to introduce this to provide an adequate amount of shelter in the north-east quadrant to house the population.

Some special traffic direction would be necessary in this area. This could be done by police action or temporary fencing which would be erected as soon as the emergency develops.

#### E. Summary of Assignment Rules

For convenience and reference, the Six Rules of Assignment given in the text are restated here:

Rule 1--Establish a center or centers of shelters and arrange population movement only in the direction of center of shelter.

Rule 2--Divide the city into sections or quadrants on the basis of (a) each section or quadrant to contain the shelter for all the population to be sheltered in that quadrant, and (b) the dividing line should be well known streets or natural boundaries to facilitate communication to the population.

Rule 3--Assign shelters in the outlying areas and away from the central district first. Start in the fringe areas and work in toward the center of shelters.

Rule 4--Always assign first, the occupants of a block in which the shelter is situated. Then assign from the direction from which people will be coming.

Rule 5--Assign blocks in groups to any one shelter so that those assigned to a shelter will find themselves leaving their homes, shops, offices, and work places as groups, and travel to shelter in groups.

Rule 6--In assigning shelters note the distance that each assigned block is from the shelter. If there are direct or nearly direct roads to the shelter area from the direction of assignment, use direct-distance measurement. If the people must follow a street pattern that is north-south and east-west or similar, then use a 45° triangle to establish distance boundaries.

#### F. Processing the Data and Presentation of Results

The use of data-processing procedures was found to be desirable to reduce the manual work and avoid error.

In developing the system using punched cards, the aim was to keep it as simple as possible using only equipment that is generally available in most communities throughout the nation. The system was also developed so as to keep cost to a minimum.

The programming procedure, card layouts, and a cost breakdown are described in detail in Appendix A to this report. A typical punched card is shown in Fig. 28.

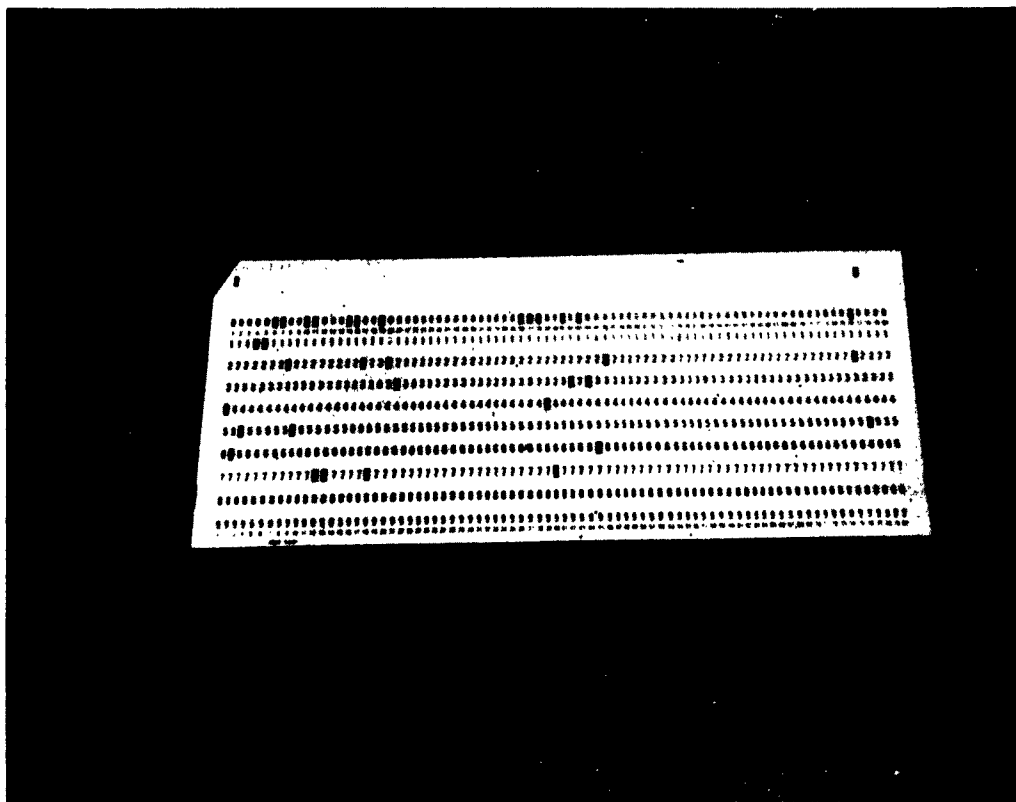


FIG. 28 A TYPICAL PUNCHED CARD

After the cards were punched, verified, and sorted, printouts were produced in various forms.

It was determined that the data should be presented for ready reference in a number of forms:

- (1) Numerical Block list showing shelter assignment.
- (2) Shelter assignment under three conditions of warning time (ample, one hour, half hour), and the list of blocks unassigned in each case.
- (3) Name and address list combining Category 2 and 3 shelters with Category 4 shelters.

The Block list shows every block in the city, including those with no population and those unassigned. It provides a very easy checklist to ensure that every block was accounted for (Figs. 29 and 30).

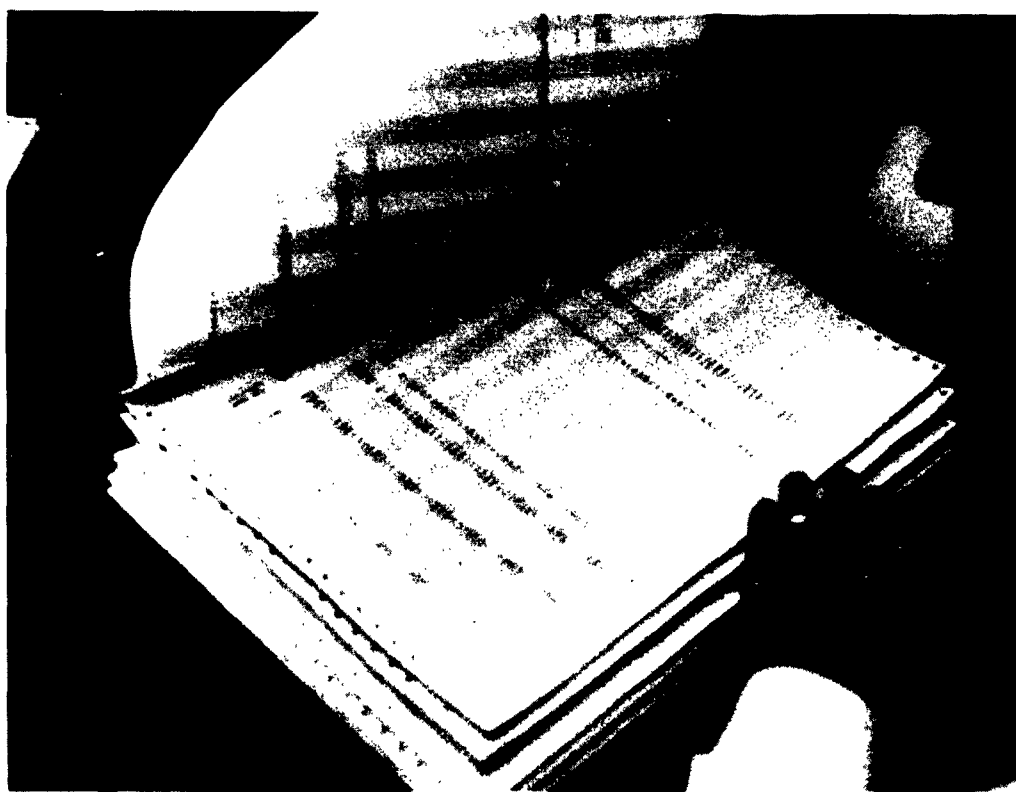


FIG. 29 BLOCK LISTING PRINTOUT



Since the list is in numerical sequence in tract and block, the Block list is a reference list to provide easy answers to inquiries as to assignment of particular streets and location.

The shelter assignment list, plus the corresponding list of unassigned blocks, shows the whole situation, and is a working document. The assigned and the unassigned lists were produced for three conditions of warning time: (1) ample time (everyone assigned reaches shelter); (2) 1-hour warning time (everyone up to 3 miles from shelter is accommodated); and (3) half an hour warning time (only those within 1-1/2 miles get into shelter).

Figures 31 and 32 show part of a typical Assignment List, and Figure 33 shows a list of unassigned blocks.

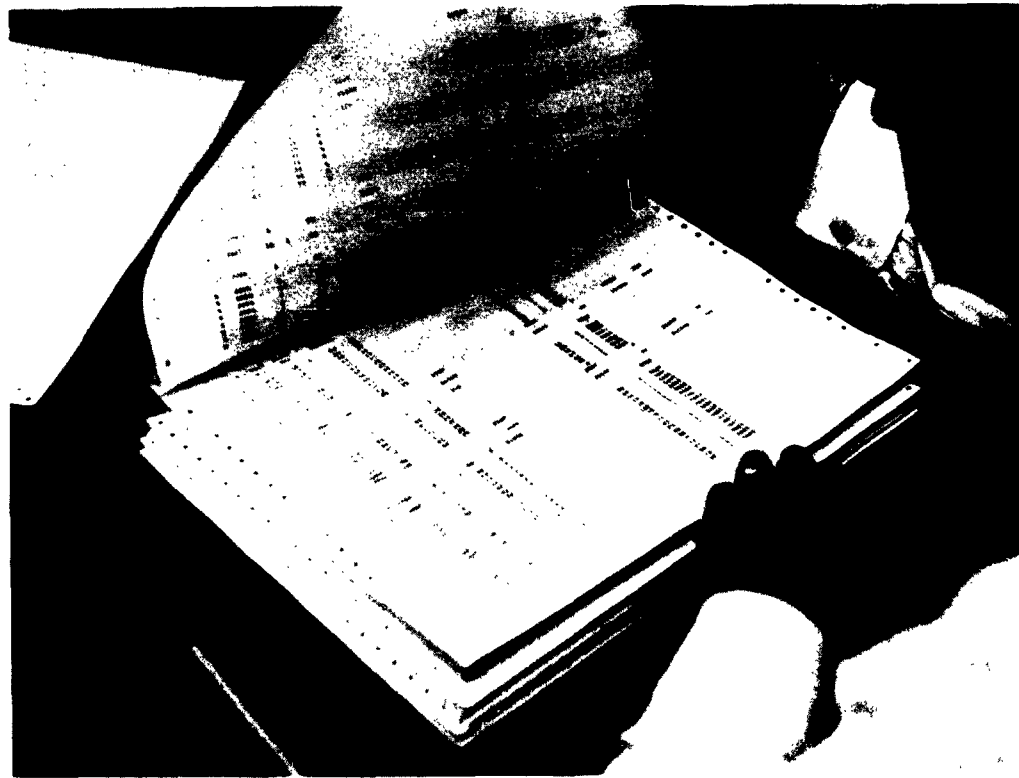


FIG. 31 SHELTER ASSIGNMENT PRINTOUT



LOC. NAME CODE NO.	BLOCK NO.	BLOCK POPULATION	DATE SURVEY
00000000	00	0	100
00010001	1	100	
00010002	2	100	
00010003	3	100	
00010004	4	100	
00010005	5	100	
00010006	6	100	
00010007	7	100	
00010008	8	100	
00010009	9	100	
00010010	10	100	
00010011	11	100	
00010012	12	100	
00010013	13	100	
00010014	14	100	
00010015	15	100	
00010016	16	100	
00010017	17	100	
00010018	18	100	
00010019	19	100	
00010020	20	100	
00010021	21	100	
00010022	22	100	
00010023	23	100	
00010024	24	100	
00010025	25	100	
00010026	26	100	
00010027	27	100	
00010028	28	100	
00010029	29	100	
00010030	30	100	
00010031	31	100	
00010032	32	100	
00010033	33	100	
00010034	34	100	
00010035	35	100	
00010036	36	100	
00010037	37	100	
00010038	38	100	
00010039	39	100	
00010040	40	100	
00010041	41	100	
00010042	42	100	
00010043	43	100	
00010044	44	100	
00010045	45	100	
00010046	46	100	
00010047	47	100	
00010048	48	100	
00010049	49	100	
00010050	50	100	
00010051	51	100	
00010052	52	100	
00010053	53	100	
00010054	54	100	
00010055	55	100	
00010056	56	100	
00010057	57	100	
00010058	58	100	
00010059	59	100	
00010060	60	100	
00010061	61	100	
00010062	62	100	
00010063	63	100	
00010064	64	100	
00010065	65	100	
00010066	66	100	
00010067	67	100	
00010068	68	100	
00010069	69	100	
00010070	70	100	
00010071	71	100	
00010072	72	100	
00010073	73	100	
00010074	74	100	
00010075	75	100	
00010076	76	100	
00010077	77	100	
00010078	78	100	
00010079	79	100	
00010080	80	100	
00010081	81	100	
00010082	82	100	
00010083	83	100	
00010084	84	100	
00010085	85	100	
00010086	86	100	
00010087	87	100	
00010088	88	100	
00010089	89	100	
00010090	90	100	
00010091	91	100	
00010092	92	100	
00010093	93	100	
00010094	94	100	
00010095	95	100	
00010096	96	100	
00010097	97	100	
00010098	98	100	
00010099	99	100	

FIG. 33 UNASSIGNED BLOCK LIST



The Name and Address List is a convenient way of relating shelter number to shelter address. The printouts provided by the Federal Government do this also, but for Lincoln there were two lists, one for each protection factor category. In practice it is more convenient to have this list consolidated. Figures 34 and 35 show the Name and Address List.

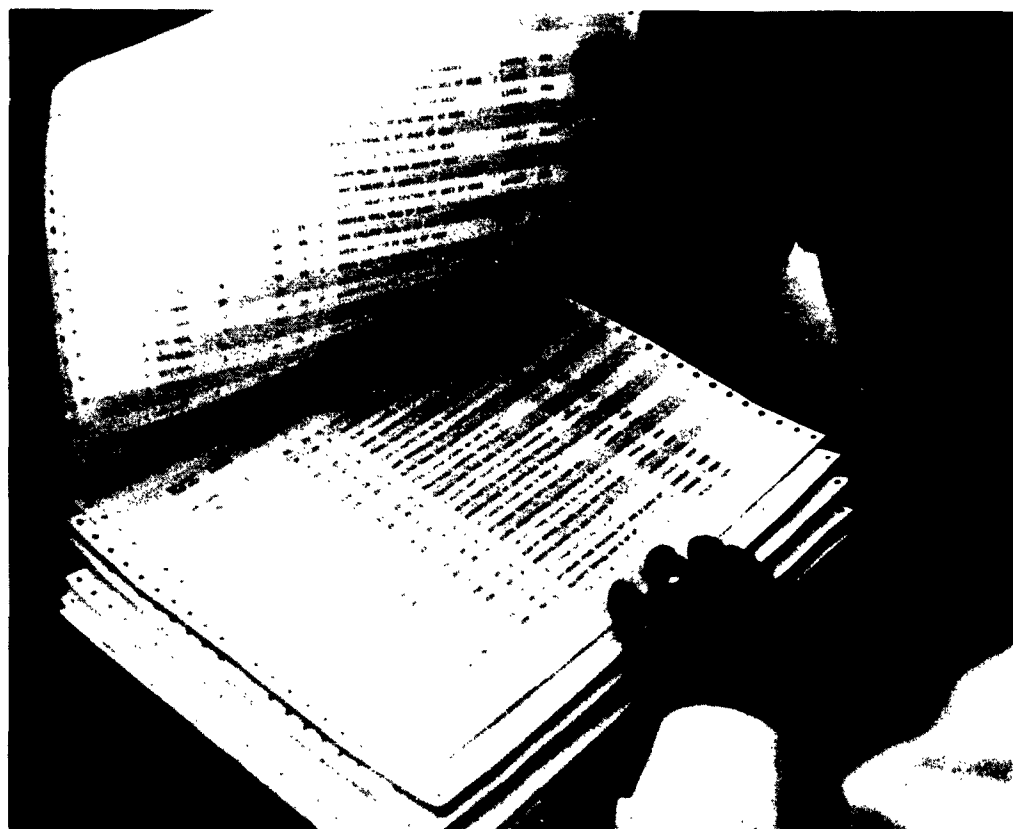


FIG. 34 NAME AND ADDRESS LIST

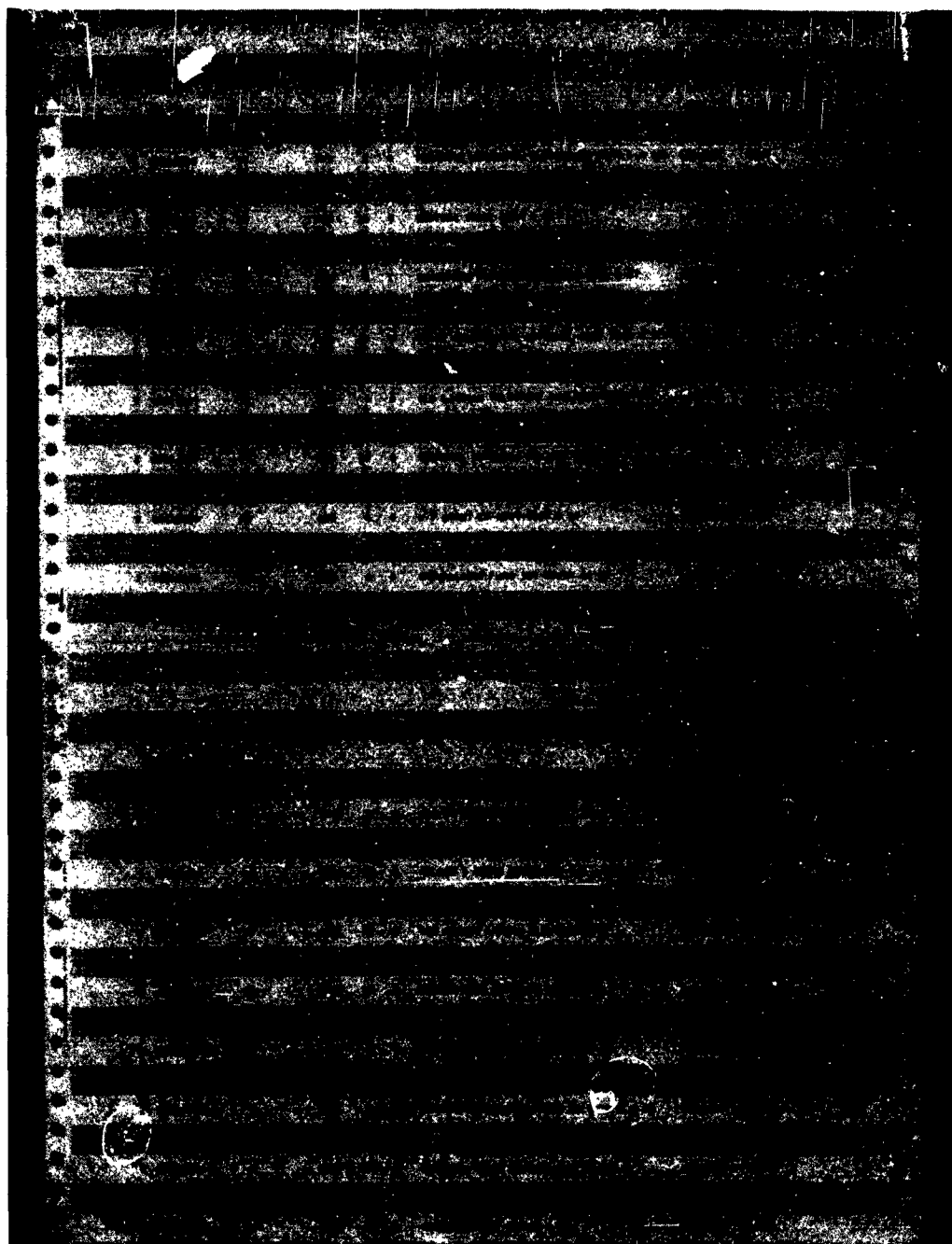


FIG. 35 NAME AND ADDRESS LIST (Closeup)

The reports should be put into an appropriate folder and tabbed for ready reference.

A number of uses of this data is given below:

1. To determine the assignment of anyone who inquires.

Method

- (a) Determine where inquirer lives
  - (b) Find location on a master map and read off tract and block number relating to that location
  - (c) From the Block Listing, read out the shelter assignment and the distance code.
  - (d) From Name and Address List, read out the name and address of the shelter.
2. To determine the state of assignment of any one shelter. Look up the shelter assignment record.
  3. Upon receipt of information concerning stocking of shelters. Write in the stocking date in the place provided in the assignment record.
  4. Upon information of changes in population distribution affecting a few blocks. Revise the Block Listing, and the Shelter Assignment listing. Determine if assignment must be changed. If so, write in changes in all the affected lists.
  5. Upon information of new shelters available, adjust the assignment records to suit and mark up all affected lists.

Periodically (such as annually) the marked lists should be examined, all changes entered in the cards and new cards punched as necessary. Following this, a new set of listings should be printed providing an up-to-date record.

The significance of date licensed, stocked, and surveyed in the listings is to have a record of how long it has been since these things were done.

It is simple, for example, to run the punched cards through a sorter so that all shelters with supplies more than one year old are separated out. Routine shelter inspection also is simplified using the same method.

Surveys of population distribution should be done periodically, such as once every two years. Sorting the punched cards will provide an immediate list of areas needing resurvey.

It was not intended and would be most confusing to attempt to present to the public the three levels of assignment resulting from three warning times. The separation was done in this report to illustrate how distance from shelter is equally important as numbers of shelters available. In any further shelter building or improvement program, there would be little gained by increasing the capacity in the business district in the city of Lincoln.

For the purpose of better understanding the shelter system, however, such an analysis of the effects of warning time is most useful. Each community should analyze its own most probable warning time, and then base the assignment on this.

#### G. Using the Data

The printouts provided by the data processing procedures comprise the permanent record for the use of the CD Director and his staff. The whole series of printouts is shown in Figure 36.

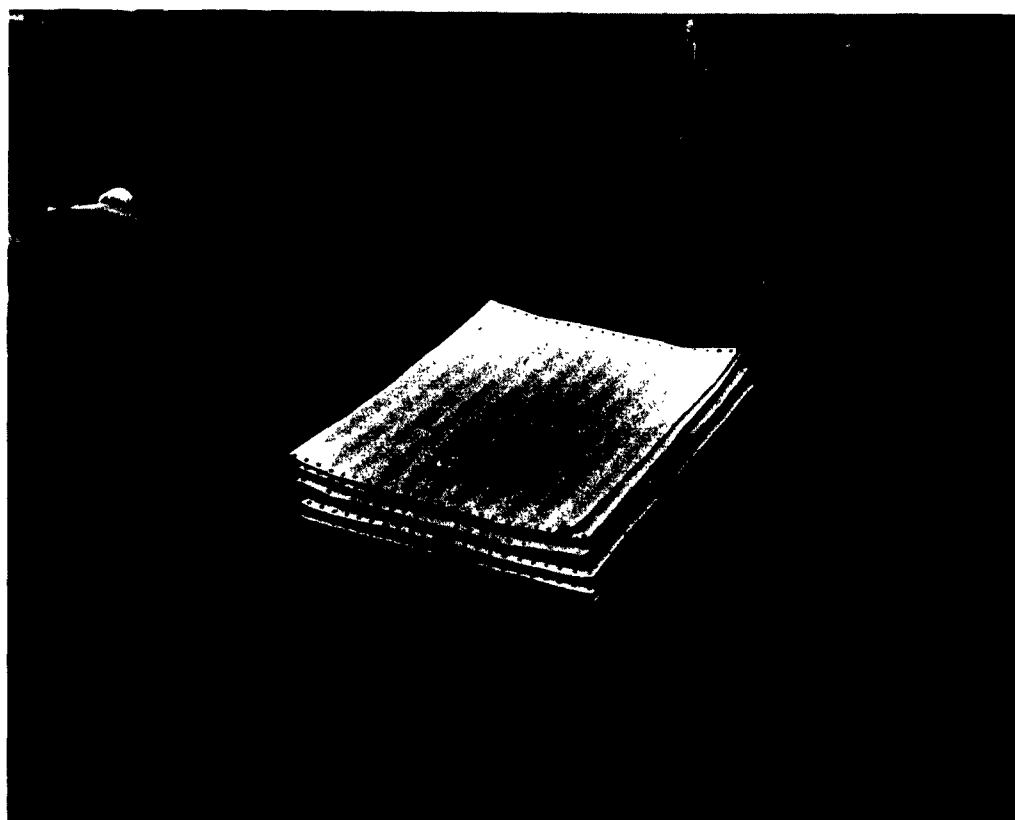


FIG. 36 COMPLETE SET OF PRINTOUTS

## V COMPUTATION OF THE DAYTIME POPULATIONS BY CENSUS BLOCK

It was determined that a separate daytime assignment of people was necessary as well as a nighttime assignment. It thereby results that many citizens in Lincoln have two shelter assignments, one for the daytime hours of approximately 7:30 AM to 5:30 PM and one for the nighttime hours of approximately 5:30 PM to 7:30 AM. Some of the population have no shelter assignments either day or night because of the lack of shelter space. Others who have shelter assignments at night have no assignment in the day because of the people who come into Lincoln from the surrounding areas in the daytime and use up some of the shelter space.

### A. Population Statistics

According to the A&E's survey, Lincoln has about 122,850 shelter spaces with a protection factor in the category of 2 or better for a daytime population of approximately 142,521. This daytime total is about 14,000 greater than the nighttime resident population of 128,521 reported by the Bureau of the Census for 1960. This 11 percent increase in daytime population is the net result of people entering the city to reach their place of employment.

The daytime population on a typical weekday is a dynamic, mobile one. Over 51,000 of the citizens leave their houses to go to work. Over 34,000 individuals are enrolled in school, from the level of kindergarten up through college. Many others leave home during the day to go shopping and for various other reasons. The problem of assigning this shifting population to shelters is compounded further by the large number of people who come into the city to work, as mentioned in the previous paragraph.

#### B. Procedure for Determining the Daytime Population by Block

There are numerous ways by which the daytime population of Lincoln, by census block, can be determined. Several techniques were studied, out of which a method was developed that was considered satisfactory for assignment purposes.

The basic procedure used in this report for determining the daytime population by census block is outlined below:

- (1) Prepare a large census block map (scale 8" = 1 mile) of Lincoln, complete with the shelters located and tracts and blocks numbered as shown in Fig. 17. (This map is basically a duplicate of the map used in making the nighttime assignments.)
- (2) Compute the daytime, resident population data and record these data by block on the large census map (described in Sec. V-C, below).
- (3) Locate by census block the key employment centers and determine the numbers of people working in each, and record these data on the large census map (see Sec. V-D, below).
- (4) Using Land Use maps, determine the industrial and commercial areas of the city (refer to Sec. V-E, below). Figure by census block the numbers of people located in the commercial and retail areas and record these data on large census map.
- (5) By census block, total the numbers resulting from Steps 2 through 4 above and record on the large census map in the appropriate blocks

For this report various documents were consulted in order to progress through Steps 1 through 5 mentioned above. In cities where these documents are not available, it would appear that similar data could be generated.

The main sources of information cited in order to progress through Steps 1 through 4 are listed below:

- (1) U.S. Census of Population and Housing. 1960, Final Report PHC(1)-79, Census Tracts, Lincoln, Nebraska, as prepared by the Bureau of the Census (see Fig. 37 and 38).
- (2) U.S. Census of Housing: 1960, HC(3), No. 236, City Blocks Lincoln, Nebraska as prepared by the Bureau of the Census.
- (3) Comprehensive Regional Plan for the Lincoln-Lancaster County Metropolitan Area, Nebraska, April 12, 1961, as prepared by Harland Bartholomew and Associates, St. Louis, Missouri.
  - (a) "Principal Employment Centers," as found on Plate 5.\*
  - (b) "Diagrammatic Land Use, 1960," as found on Plate 5.\*\*
  - (c) "Major Elements of the Regional Center," Plate 18.\*\*\*
  - (d) Air Photographs of Lincoln.†
- (4) "Lincoln, Nebraska Fallout Shelter Survey," by Selmar A. Solheim Associates, March 1, 1962 (see Fig. 1). (Sheet 1 of these maps contained the census tract daytime population estimates used in this report.)

#### C. Computing the Daytime Resident Population by Block

It was determined that by using the data generated by the Bureau of Census in 1960 as published in U.S. Census of Housing PHC(1)-79 and its report HC(3) No. 236, reasonable data could be gathered to establish Lincoln's daytime population by census block. The U.S. Census of Housing, 1960, Report HC(3) No. 236 has already been mentioned. The U.S. Census, 1960, Report PHC(1)-79 is shown in Figs. 37 and 38. Figure 37 shows data describing the General Characteristics of the

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\* Fig. 39  
\*\* Fig. 40  
\*\*\* Fig. 43  
† Figs. 41 and 42



## CENSUS TRACTS

Prepared under the supervision of  
HOWARD G. BRUNSMAN, Chief,  
Population Division, and  
WAYNE F. DAUGHERTY, Chief,  
Housing Division

FIG. 37 U.S. CENSUS OF POPULATION AND HOUSING: CENSUS TRACTS

Census Tracts

LABOR FORCE CHARACTERISTICS OF THE POPULATION, BY CENSUS TRACTS: 1960—Con.

[Based on 25-percent sample. Percent not shown where base is less than 300]

SUBJECT	LINCOLN—CON.													
	TRACT 0009	TRACT 0010	TRACT 0011	TRACT 0012	TRACT 0013	TRACT 0014	TRACT 0015	TRACT 0016	TRACT 0017	TRACT 0018	TRACT 0019	TRACT 0020	TRACT 0021	TRACT 0022
EMPLOYMENT STATUS, OCC., & INDUSTRY														
MALE, 14 YEARS OLD AND OVER . . . . .	1 470	1 425	536	971	1 263	2 049	1 762	2 637	1 484	1 139	1 877	2 191	972	2 369
LABOR FORCE . . . . .	1 107	1 244	477	901	1 206	1 723	1 500	2 191	1 199	906	1 002	1 719	767	1 947
PERCENT OF TOTAL . . . . .	75.3	87.4	89.0	92.8	95.5	88.1	85.1	81.6	77.8	79.5	63.5	78.5	78.9	81.6
CIVILIAN LABOR FORCE . . . . .	1 028	1 190	454	875	1 105	1 645	1 434	2 034	999	814	938	1 481	687	1 760
EMPLOYED . . . . .	1 003	1 154	443	868	1 101	1 644	1 407	1 966	952	794	844	1 412	671	1 707
UNEMPLOYED . . . . .	25	34	13	51	4	19	29	68	47	60	92	69	16	73
PERCENT OF CIV. LABOR FORCE . . . . .	2.4	2.9	2.9	4.0	0.4	1.1	2.0	3.3	4.7	7.4	6.5	4.7	2.3	4.1
NOT IN LABOR FORCE . . . . .	363	179	59	70	87	386	362	488	289	223	875	472	208	482
FEMALE, 14 YEARS OLD AND OVER . . . . .	1 296	1 473	567	777	1 445	2 235	2 088	3 038	2 025	1 378	1 269	3 295	969	3 153
LABOR FORCE . . . . .	580	688	280	338	450	1 063	968	1 277	1 020	698	606	2 075	610	1 566
PERCENT OF TOTAL . . . . .	44.8	48.6	47.7	34.6	31.1	47.6	46.4	42.0	50.4	50.7	63.7	63.0	42.3	49.7
EMPLOYED . . . . .	564	604	280	330	429	1 029	934	1 212	962	655	782	1 907	399	1 523
UNEMPLOYED . . . . .	16	24	...	8	21	34	34	66	58	43	24	79	11	43
PERCENT OF CIV. LABOR FORCE . . . . .	2.8	3.8	...	2.4	4.7	3.2	3.5	5.1	5.7	6.2	3.0	3.8	2.7	2.7
NOT IN LABOR FORCE . . . . .	716	885	307	639	995	1 172	1 120	1 761	1 005	680	663	1 280	569	1 587
MARRIED WOMEN IN CIV. LABOR FORCE . . . . .	363	408	142	212	280	650	578	844	544	349	342	641	261	641
WITH OWN CHILDREN UNDER 6 . . . . .	70	142	72	101	120	280	240	333	217	132	117	211	97	172
MALE, EMPLOYED . . . . .	1 003	1 154	443	764	1 101	1 644	1 407	1 966	952	794	844	1 412	671	1 707
PROFESS'L, TECHN'L, & KINDRED WORKERS . . . . .	271	178	44	182	264	393	248	400	166	60	128	206	13	134
MGRS., OPS., & PROPRI'S, INCL. FARM . . . . .	144	127	53	121	164	337	309	290	100	51	49	171	28	233
CLERICAL AND KINDRED WORKERS . . . . .	90	132	62	67	91	148	118	200	103	72	64	144	48	163
SALES WORKERS . . . . .	61	71	33	70	197	238	184	294	93	49	20	127	96	137
CRAFTSMEN, FOREMEN, & KINDRED WORKERS . . . . .	165	279	115	161	104	249	290	398	172	184	181	230	208	408
OPERATIVES AND KINDRED WORKERS . . . . .	85	197	78	113	50	124	114	184	145	142	80	166	198	333
PRIVATE HOUSEHOLD WORKERS . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...
SERVICE WORKS., EXC. PRIV. HOUSEHOLD . . . . .	41	68	17	23	22	39	60	125	88	74	183	160	77	153
LABORERS, EXCEPT MINE . . . . .	118	72	31	19	26	48	45	73	52	69	92	101	36	88
LABORERS, EXCEPT MINE . . . . .	8	12	10	18	14	24	24	42	33	55	79	63	30	68
OCCUPATION NOT REPORTED . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...
FEMALE, EMPLOYED . . . . .	564	604	280	330	429	1 029	934	1 212	962	655	782	1 907	399	1 523
PROFESS'L, TECHN'L, & KINDRED WORKERS . . . . .	111	90	37	48	98	216	221	222	168	11	73	252	24	168
MGRS., OPS., & PROPRI'S, INCL. FARM . . . . .	35	4	18	4	18	39	41	65	47	32	54	54	12	37
CLERICAL AND KINDRED WORKERS . . . . .	233	232	88	144	149	354	392	395	368	201	299	918	63	497
SALES WORKERS . . . . .	38	45	14	23	48	97	80	150	73	33	177	173	97	177
CRAFTSMEN, FOREMEN, & KINDRED WORKERS . . . . .	4	17	4	4	5	13	7	8	8	8	8	20	18	19
OPERATIVES AND KINDRED WORKERS . . . . .	52	71	34	24	8	67	49	98	67	88	51	150	93	164
PRIVATE HOUSEHOLD WORKERS . . . . .	30	43	17	61	58	61	58	64	62	23	23	177	173	177
SERVICE WORKS., EXC. PRIV. HOUSEHOLD . . . . .	51	78	61	17	21	145	89	133	137	127	164	258	113	297
LABORERS, EXCEPT MINE . . . . .	8	...	5	4	...	...	8	...	...	...	...	...	4	...
LABORERS, EXCEPT MINE . . . . .	8	12	10	18	14	24	24	42	33	55	79	63	30	68
OCCUPATION NOT REPORTED . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...
TOTAL EMPLOYED . . . . .	1 567	1 760	723	1 074	1 530	2 673	2 341	3 178	1 934	1 499	1 628	3 399	1 070	3 230
PRIVATE WAGE AND SALARY WORKERS . . . . .	610	1 313	554	789	1 028	1 775	1 694	2 294	1 387	1 041	1 328	2 427	934	2 427
GOVERNMENT WORKERS . . . . .	576	334	126	222	302	566	442	672	454	274	241	845	108	639
SELF-EMPLOYED WORKERS . . . . .	124	93	43	65	200	295	195	206	119	90	90	127	31	15
UNPAID FAMILY WORKERS . . . . .	55	...	...	...	...	...	...	...	...	...	...	...	...	...
TOTAL EMPLOYED . . . . .	1 567	1 760	723	1 074	1 530	2 673	2 341	3 178	1 934	1 499	1 628	3 399	1 070	3 230
MINING . . . . .	92	120	...	...	...	...	...	...	...	...	...	...	...	...
CONSTRUCTION . . . . .	183	400	148	180	201	343	292	373	186	174	81	200	75	208
FURNITURE & LUMBER & WOOD PRODUCTS . . . . .	4	...	...	...	...	...	...	...	...	...	...	...	...	...
METAL INDUSTRIES . . . . .	7	19	15	21	16	19	11	23	8	12	17	15	13	30
MACHINERY . . . . .	12	61	21	20	41	59	52	8	12	9	29	24	78	78
TRANSPORTATION EQUIPMENT . . . . .	16	65	18	16	9	31	18	40	20	12	...	33	10	30
OTHER DURABLE GOODS . . . . .	4	4	5	11	21	12	25	17	...	16	...	14	9	21
FOOD AND KINDRED PRODUCTS . . . . .	43	135	32	51	46	80	89	93	94	65	39	144	78	280
TEXTILE AND APPAREL PRODUCTS . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...
PRINT., PUBLISH'G, & ALLIED INDUS. . . . .	70	76	30	32	33	90	53	32	32	8	71	48	88	88
OTHER NONDUR. (INCL. NOT SPEC. NFB) . . . . .	27	36	31	39	43	62	61	54	16	12	12	46	22	46
RAILROAD AND RAILWAY EXPRESS SERVICE . . . . .	32	80	37	34	16	97	79	134	36	22	26	82	106	149
OTHER TRANSPORTATION . . . . .	33	41	14	8	8	21	62	43	32	21	27	36	48	51
COMMUN., UTIL., & SANITARY SERV. . . . .	47	83	37	33	54	58	112	151	69	74	52	170	43	97
WHOLESALE TRADE . . . . .	35	106	19	44	103	180	68	149	47	61	22	95	21	76
EATING AND DRINKING PLACES . . . . .	62	36	22	4	40	69	64	65	57	88	88	61	66	87
OTHER RETAIL TRADE . . . . .	166	250	98	167	241	390	373	940	278	203	224	484	124	586
BUSINESS AND REPAIR SERVICES . . . . .	35	60	12	17	46	32	113	91	64	65	31	108	61	89
PRIVATE HOUSEHOLDS . . . . .	36	43	17	49	63	65	76	73	68	49	26	84	90	119
OTHER PERSONAL SERVICES . . . . .	39	24	13	22	24	88	50	108	100	59	280	181	47	98
HOSPITALS . . . . .	34	39	33	33	41	93	219	96	72	46	32	139	46	461
EDUCATIONAL SERVICES . . . . .	427	144	56	125	185	294	199	323	215	91	190	373	33	148
OTHER PROFESSIONAL AND RELATED SERV. . . . .	61	75	28	34	127	186	121	189	139	92	102	144	39	107
PUBLIC ADMINISTRATION . . . . .	114	153	60	100	128	205	181	275	194	111	47	393	66	194
OTHER INDUSTRIES (INCL. NOT REPORTED) . . . . .	143	106	75	119	181	313	235	390	263	179	268	522	49	298
MEANS OF TRANSPORT, & PLACE OF WORK														
ALL WORKERS (INCL. ARMED FORCES) . . . . .	1 548	1 766	727	1 162	1 599	2 619	2 337	3 196	2 027	1 473	1 656	3 535	1 066	3 333
PRIVATE AUTOMOBILE OR CAR POOL . . . . .	1 096	1 481	613	989	1 369	2 156	1 850	2 470	1 441	701	629	1 789	796	2 235
RAILROAD . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...
SUBWAY OR ELEVATED . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BUS OR STREETCAR . . . . .	106	109	37	32	82	140	197	322	211	144	96	306	98	413
WALKED TO WORK . . . . .	159	62	36	22	44	127	112	133	205	466	893	1 141	186	364
OTHER MEANS . . . . .	47	67	9	88	23	66	26	38	64	68	51	61	63	60
WORKED AT HOME . . . . .	133	31	28	28	86	70	81	121	60	53	65	46	23	132
NOT REPORTED . . . . .	11	16	5	5	20	40	111	82	64	41	151	172	13	104
INSIDE SMSA . . . . .	1 403	1 703	696	1 066	1 480	2 419	2 199	3 027	1 915	1 397	1 480	3 269	1 046	3 194
LINCOLN CITY . . . . .	1 289	1 328	430	883	1 350	2 267	2 016	2 788	1 659	1 221	1 302	2 982	904	2 799
REMAINDER OF LANCASTER COUNTY . . . . .	134	177	66	181	139	152	183	399	260	176	178	377	162	395
OUTSIDE SMSA . . . . .	108	31	19	46	94	80	78	64	32	30	43	89	22	64
PLACE OF WORK NOT REPORTED . . . . .	37	32	12	30	12	120	60	103	60	46	133	177	20	113

FIG. 38 LABOR FORCE CHARACTERISTICS

Population, by Census Tract (Table P-1). The items Head of Household, Population in Group Quotas (Other), and College enrollment are underlined in order to point up specific items used in developing the daytime population numbers. Figure 38 describes the Labor Force Characteristics of the Population by Census Tract (Table P-3). The underlined items of Married Women in Labor Force (Husband Present), Total Employed, and Worked at Home were all used in arriving at Daytime Population figures.

In essence the principle used was to start with the nighttime population of a tract, to subtract all those clearly leaving home during the day, and to multiply the night block populations by the ratio of remaining resident tract population divided by the resident night tract population; a number that was found to vary between 0.5 and 0.7 for each tract. This gave the resident day population by block. The next step was to take the total day population of the tract (computed by the A&E during the shelter survey), and distribute the difference of the total day population and the total resident day population into the blocks found to be Industrial and Commercial areas. Land use and principal employment centers maps and air photographs were used to make the judgments necessary for this distribution. One example of computing the daytime resident population is described in Table II, wherein the calculations for tract 16 are recorded. These calculations will be used throughout this section to describe one method of computing the daytime block populations.

The daytime resident population of 4088 for tract 16 is recorded on line 11 in Table II. This 4088 figure was determined by subtracting the 3369 people on line 10, who leave tract 16 to go to work or college, from the 7475 people on line 1, who comprise the nighttime resident population. The data in line 1 were taken from the report HC(3) No. 236 while the data recorded in lines 2 through 10 are from Report PHC(1)-79.

A detailed description for computing the daytime resident population follows. Two different methods, A and B, were used in order to determine the number of people who leave a specific tract for work and

TABLE II

DAYTIME POPULATION CALCULATIONS  
Census Tract 16  
Lincoln, Nebraska

LINE	ITEM	METHOD A	METHOD B	FINAL CALCULATIONS
1	Total Night Population			7457
2	Heads of Household		2605	
3	Working Wives		770	
4	Population in Group Quarters		31	
5	Working Population (Total Lines 2-4)	3178	3406	
6	Working at Home	- 131	- 131	
7	Working Away from Home	3047	3275	
8	College Enrolled	416		
9	Total Away from Home	3463	3275	
10	Total Away from Home - Average of Methods A & B			-3369
11	Daytime Resident Population			4088
12	Ratio of Res. Day Pop./Res. Night Pop. (Line 11/Line 1)			(0.548)
13	Given Day Population (A&E Report)			5587
14	Population Away from Home in the Tract (Line 13 - Line 11)			1499
15	Employed Population Located in Known Employment Centers			- 125
16	Retail and Commercial Population			1374

NOTE: The 1374 persons making up the Retail and Commercial Population were distributed evenly over 8 specific census blocks in Tract 16, thus resulting in 171 persons per block affected.

college as reported on line 9. When Method A resulted in a greater value than Method B the values for each method were averaged and recorded on line 10. When Method A resulted in a lower value than Method B, Method A alone was used and no average of Methods A and B was taken. Though Method A was a more simple method of calculating the number of people leaving home, this method was believed not to be sufficiently accurate in those tracts where a large number of college students were living. Inasmuch as the census data did not report the number of college students who worked, Method A might be expected to report too large a number of people leaving a tract because of "double accounting." Method B included some college students under the items of Heads of Households and Populations in Group Quarters. Method B served both as a check on Method A and as a means of permitting greater judgment in evaluating the "population away from home" figures.

Method A--Away from Home total (line 9) was determined by subtracting the Working at Home population (line 6) from the Working Population (line 5) and then adding the College Enrolled population (line 8).

Method B--Away from Home total (line 9) was then determined by subtracting the Away from Home Population (line 10) from the Total Night Population (line 1). The daytime resident population by census block was calculated by multiplying the ratio of the day to night resident population (line 12), by the respective nighttime block populations recorded in census report HC(3) No. 236. This ratio of the day to night resident population (line 12) was calculated by dividing line 11 by line 1.

As the population figures for the daytime resident population were developed, they were written into the appropriate census blocks as marked out on a large census block map prepared for Lincoln (scale 8" = 1 mile). As a second source of future reference, they were also written in the margin alongside the nighttime resident population block figures found in census report HC(3) No. 236.

#### D. Locating the Key Employment Centers

The key employment centers along with an estimate of the numbers of people employed were determined from an exhibit found in the Comprehensive Regional Plan for the Lincoln City-Lancaster County Metropolitan Area of Nebraska as prepared by Harland Bartholomew and Associates. The Principal Employment Centers in Lincoln with fifty or more employees, as taken from the Regional Plan, are shown in Fig. 39.

Table II shows that 125 employees were found to work in Tract 16 (line 15) as a result of information taken from Fig. 39, the Principal Employment Centers map. These 125 employees were recorded on the large census block map along with the daytime, resident population. In each tract the employees were distributed for the appropriate block or blocks, as located on the Principal Employment Centers map.

#### E. Developing Land Use Maps and Extrapolating Data

An important part of determining the daytime population figures is to ascertain the location and approximate numbers of people visiting the retail and commercial centers of a city. Because of the shifting, changing nature of this population, it is only possible to arrive at what appears to be a good reasonable average number of people for a given area.

Returning to our example of Tract 16 described in Table II, there were found to be approximately 1374 people (line 16) visiting the retail and commercial areas of Tract 16. This number was computed by subtracting the Employed Population (line 15) from the Population Away from Home (line 14), who are in Tract 16 during the day. The Population Away from Home was determined by subtracting the Daytime Resident Population (line 11) from the Given Day Population (line 13). The Given Day Population was taken from data generated by the A&E population survey.

By this method it was not too difficult to arrive at a figure which suggested the total number of people visiting the retail and commercial area of a tract. However, it was more difficult to determine the actual

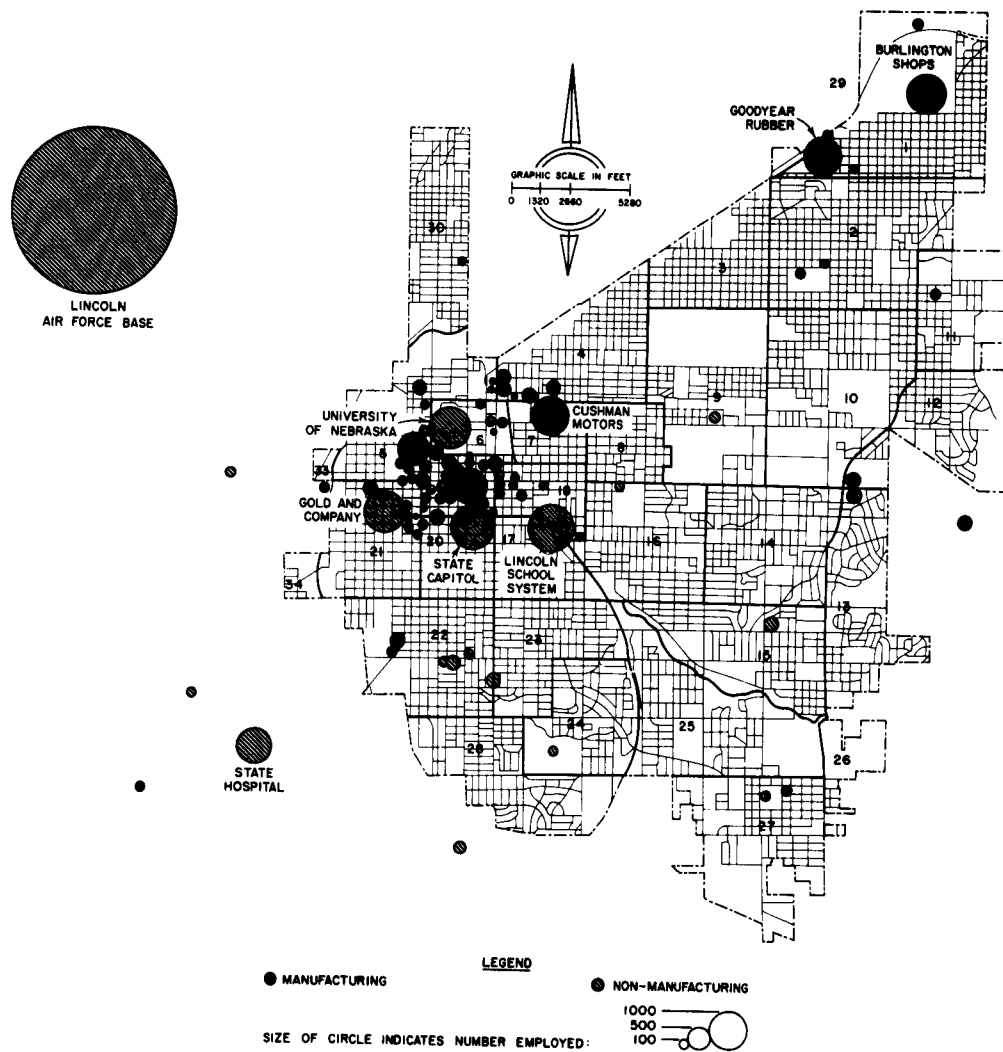


FIG. 39 PRINCIPAL EMPLOYMENT CENTERS

blocks within a tract in which these people are located, as well as their distribution.

In this case, city land use maps and an air photograph, as taken from the 1961 Comprehensive Regional Plan served as the basis for estimating the locations of the retail and commercial centers. A Diagrammatic Land Use map for the city is shown in Fig. 40. The black areas, which note the commercial centers of the city were located and marked with pencil on the large census block map. The outline of these commercial areas circumscribed those census blocks located in commercial and retail areas. In Tract 16, eight (8) census blocks were found to contain retail and commercial areas, each considered to be loaded with an equal density of population. Therefore, the 1374 Retail and Commercial Population on line 16 of Table II was divided by 8, and 171 persons were added to the appropriate blocks on the large census map.

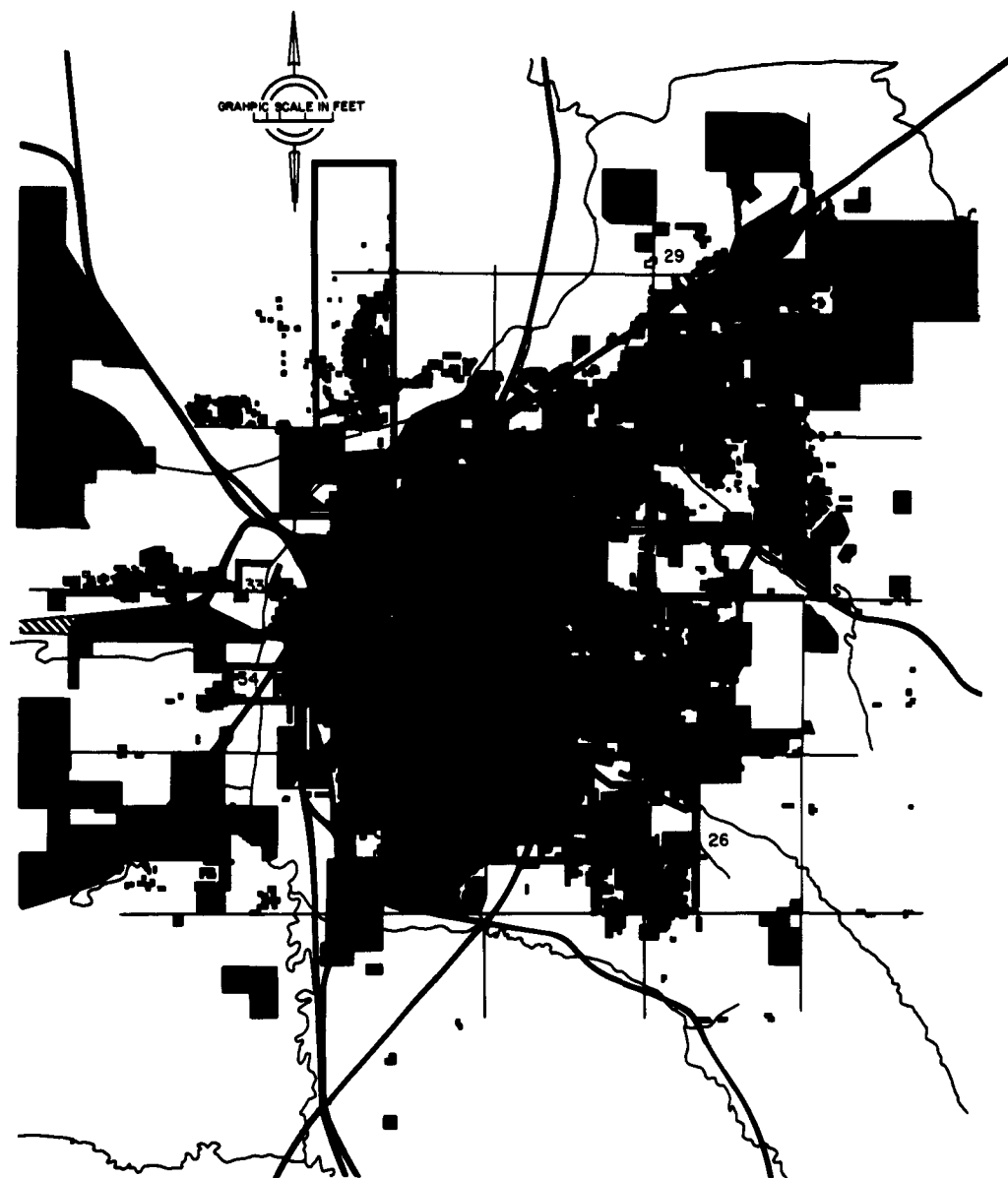
Other census tracts posed special problems in assessing the population. In these cases more detailed information was required. As an example, air photographs such as are shown in Figs. 41 and 42 helped to describe the characteristics of the census blocks. Figure 41 describes a typical suburb area and serves to confirm the absence of commercial or retail areas in tract 13. Figure 42 gives detail as to the size and density of buildings to be found in Tract 19 by census block in the downtown center of Lincoln.

Figure 43 is a sketch of the Existing Land Use for Tract 19 in the downtown district of Lincoln. This sketch along with the air photograph in Fig. 42 was most useful in evaluating the retail and commercial traffic for the high-density, downtown area. In those areas of the map in Fig. 43 where the "Retail Core" and "Private Office Areas" were overlapping, population densities were increased accordingly.

#### F. Computing a Final Daytime Population Total per Census Block

Previous paragraphs have pointed out that as the daytime population data were generated for the resident population, the employment population, and the commercial population, the respective population figures





**LEGEND**

- |             |                        |
|-------------|------------------------|
| RESIDENTIAL | INDUSTRIAL & RAILROADS |
| COMMERCIAL  | PUBLIC & SEMI-PUBLIC   |

NOTE STREETS ARE FOR GRAPHIC REFERENCE ONLY

FIG. 40 LAND USE MAP



FIG. 41 TYPICAL SUBURB



FIG. 42 CENTRAL BUSINESS DISTRICT

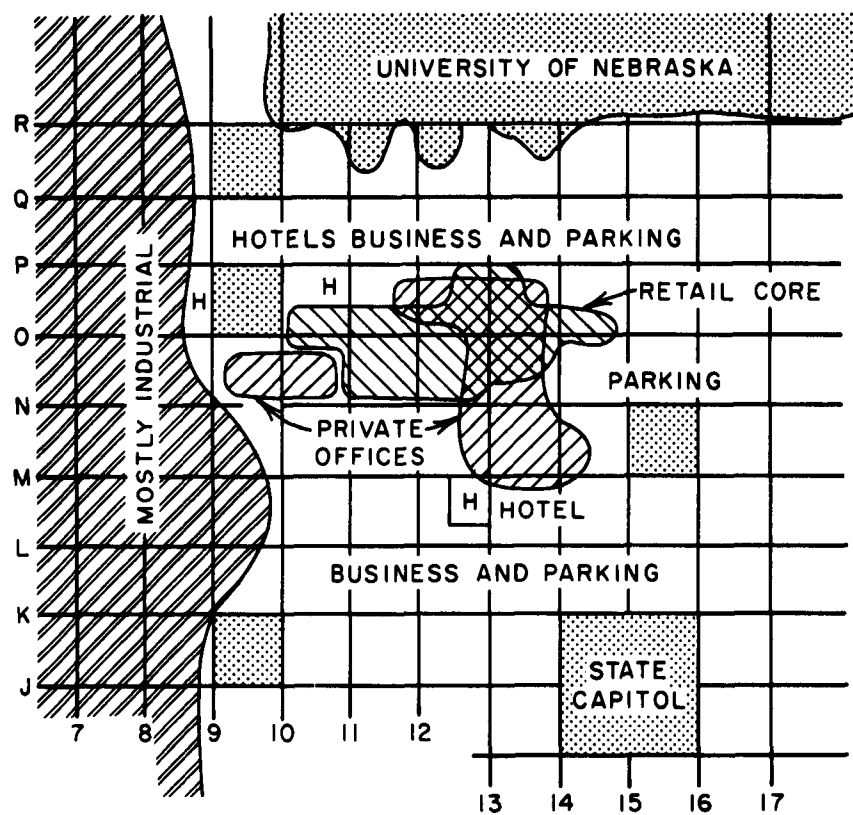


FIG. 43 BUSINESS DISTRICT LAND USE

were placed in the appropriate blocks of the large census map. These figures were then totaled in each block and the resulting sum was the block population figure used in making the daytime assignment.

In addition to recording data on the map, it is recommended that the daytime population figures by block be written opposite the appropriate blocks in the U.S. Census Report HC(3) No. 236. Data recorded in this manner is most useful as a reference and as a source of checking the accuracy of the actual assignment of people to shelters.

The final daytime population total arrived at by the technique described in Secs. V-A through V-F was 143,521. This number is somewhat greater than the A&E's estimate of 142,521. The two numbers do not agree since the A&E's population estimate by tract was not used in those cases where the method of assessing population as discussed in this section dictated otherwise.

## VI PUBLIC INDOCTRINATION

The problems of informing the public of shelter assignments have been important considerations in developing the method of assignment. Observations of public reaction to the shelter program suggest that the assignment method must support the proposition that between 10 and 50 percent of the people will not know their assignment in an emergency.

### A. Public Reaction

It is a regrettable fact also that many people actively resist acquiring knowledge about a shelter program, and presumably sway some less certain people. It is further predicted that, in spite of this, when faced with a sudden emergency these people will be just as anxious to find shelter as everyone else, and will, consistent with their beliefs up to that time, have made no preparations.

The assignment method has been designed to rely on the 50 percent (minimum) who do know their assignment to bring in those who do not by the follow-the-crowd principle.

### B. Purpose and Method of Indoctrinating the Public

The purpose of the public indoctrination program should therefore be aimed at informing as many people as will permit, of their specific assignment, and at implanting some general rules and guidances in the minds of everyone.

It is considered that the quadrant method which gets people to stay in their own quadrant by the simple message of "don't cross 10th Street and 'O' Street wherever you are" would be effective. Also, this simple message conveyed by radio, newspapers, and television will not be forgotten.

It will be necessary to back this message up with a clear explanation of how the shelter assignment is designed; of how the population

distribution has been used to account for people moving around in their everyday lives, regardless of whether they are at home, at work, visiting their friends and relations, or just shopping downtown; that surveys have been done and assignments made that will accept people being away from home. In most cases the newspapers would demand and publish this information at the time the message was sent for publication.

#### C. Communicating the Specific Assignment

Having established the simple quadrant rule in the minds of the people, the next step is to try and indoctrinate people into their specific assignment.

People spend most of their time at home and at work, both locations being well known to them. In these two locations, specific assignment can be communicated. At work, the assignment should be permanently posted on notice boards and in the same locations as fire instructions.

For informing people at home, a number of alternatives are available:

- (1) Post cards sent to each home stating the assignment. This is a big task and, to be effective, needs to be repeated about once every six months to maintain the information in people's minds.
- (2) Arrange lectures to local groups such as American Legion, Red Cross, P.T.A., Women's Groups.
- (3) Have a notice published in the front of the telephone book which gives the CD Office telephone, and invites inquiries as to shelter location and assignment. This method requires the CD Office to be prepared for large numbers of phone calls whenever international crises seem to be imminent.

#### D. Communicating Through Maps

For a more general method of spreading the information, two maps should be produced showing the assignments. Such maps are not as complex as might be imagined. By the process of assigning blocks in groups to shelter, the bounds of areas assigned to any one shelter are often

quite large, and it becomes much easier to interpret by looking at a map, what the assignment is.

Such maps should be displayed, with explanations, in public places such as libraries, and in the waiting rooms at clinics, hospitals, and other public buildings.

#### E. Communicating with the Unassigned Population

There remains the problem of what to do about those that are not assigned, or assigned only at night and not by day.

A frank explanation should be made to the residents of such areas, giving:

- (1) The total population compared to available shelters.
- (2) The method of assignment, which is that those nearest to shelters are assigned first.
- (3) Recommendations for home shelter planning.
- (4) Details of future plans for building shelters or improving presently substandard facilities in those areas.
- (5) Reasons to avoid overcrowding of existing shelters. The parallel of the lifeboat which, when overloaded, sinks, drowning everyone, could be used here.

## VII MAN-DAYS AND COST REQUIRED TO MAKE THE SHELTER ASSIGNMENTS

An estimate is itemized below with respect to the man-days required to produce the assignment maps, compute the assignment data, and make the actual shelter assignments. It is recommended that two planners work together in producing the shelter assignments. The estimate of man-days presumes that two planners rather than one are involved.

### A. Required Man-Days

An estimate of the total man-days required for the planners to progress through the assignment process is summarized below:

Production of two suitable maps of the city of Lincoln, marking the tracts and blocks, and entering the shelters in both maps and the night population on one map	7 man-days
Computing the day population and entering it on the map	4 man-days
Assigning both day and night population, including determination of sectors or quadrants, distance measurement, and checking	20 man-days
Coloring maps day and night for easy reference	1 man-day
<hr/>	
Total assignment effort	32 man-days

### B. Estimate of Cost

In order to determine the cost of making the assignments, the 16 man-days computed above would be multiplied by the appropriate man-day wage scale. This wage scale would be determined by the professional classification of the planners selected.



The cost of employing the use of data-processing equipment in order to produce the required shelter assignment reports is discussed in Appendix A. For this particular effort, about 63 machine- and man-hours were required at a total cost of approximately \$900.

APPENDIX A

DATA PROCESSING PROCEDURE

## APPENDIX A

### DATA PROCESSING PROCEDURE

#### 1. Data-Processing Equipment

Reports such as are shown in Fig. A-1 were prepared by the use of electronic data processing equipment. The basic data processing equipment consisted of the following items:

- (1) Key-Punch, used to record the information found in the data sheets onto the cards.
- (2) Key Verifier, which verifies the accuracy of the key punching operation.
- (3) Interpreter, which prints onto a card the basic data to be found on the card.
- (4) Sorter, which arranges the cards in the order required.
- (5) Collator, which matches and merges the Shelter Master Cards with the Block Detail Cards.
- (6) Tabulator-Printer, which prints and lists the data from the cards onto the report paper, as is demonstrated in Fig. A-2. To use the printer a control board is wired up as shown in A-3.

The above kinds of equipment are available to all cities in the United States. Most cities of 100,000 population or greater could be expected to have data-processing equipment operating within their own boundaries or in some city not too many miles distant. Universities, industrial centers, and commercial centers are typical of the places in which a civil defense official could look to find data processing equipment. The owners of data-processing equipment frequently welcome outside contracting of such equipment so as to help fill in the idle times of the equipment.

There is great flexibility as to the actual locality in which the key punching and processing of the "punched cards" is done. After the basic shelter assignment data is generated and recorded for a city, the

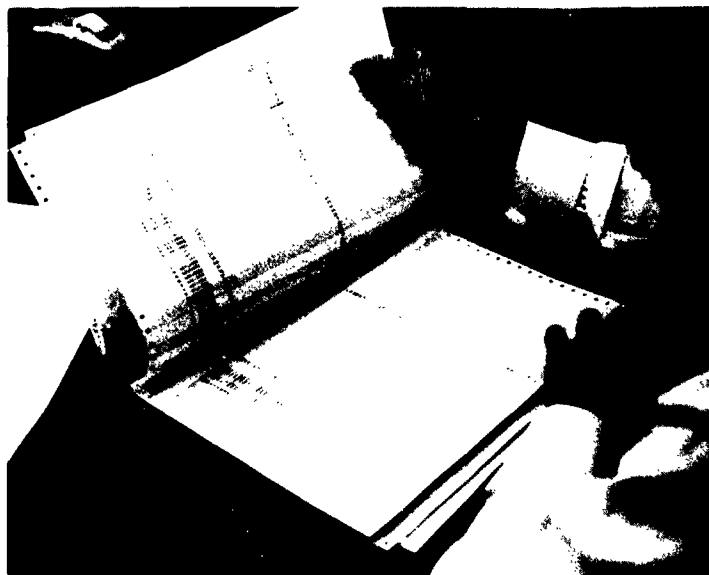


FIG. A-1 TYPICAL REPORT



FIG. A-2 TABULATOR-PRINTER IN OPERATION



FIG. A-3 PRINTER CONTROL BOARD

cards may be key-punched and processed at a central data-processing office, serving either a city, a state, a region, or the nation as a whole. The punched cards for this research report were key-punched and processed by a commercial data-processing firm that serves many clients in the San Francisco Bay area.

It is believed that the time analyses reported under Sec. 6 of this Appendix and the cost analyses recorded under Sec. 7 would be representative of the time and cost required to produce a similar set of reports in most sections of the U.S. for a city typical of Lincoln, using local data-processing equipment. However, it is to be expected that items of cost and/or the form of the reports might vary, depending upon the manufacturer and the type of equipment.

A discussion follows which describes the data-processing procedure followed in producing the reports for Lincoln, Nebraska.

## 2. Punching and Verification Instructions

Punching and verification instructions are necessary before the "Card Forms" can be designed and the cards punched. Figures A-4 through A-7 record the key punching instructions prepared in order that the following cards could be designed and punched:

- (1) The Shelter Master Cards with name and address
- (2) The Shelter Card Master
- (3) The Block Detail Cards for day and night assignments
- (4) The Unassigned Block Cards.

These instruction sheets describe the fields, or numbered columns, to be used up by specific cards in order to report out the shelter assignment data. A total of 80 columns were available in each of the punch cards used in this report.

## 3. Multiple Card Layout

The data recorded in the Punching and Verifying Instruction sheets were used to prepare the Multiple Card Form shown in Fig. A-8. This multiple card form was the basis for designing six (6) different decks

## PUNCHING AND VERIFICATION INSTRUCTIONS

**CUSTOMER** Civil Defense

**REPORT TITLE**      **Shelter Master Cards (Name and Address)**

**Estimate No.**

REPORT No. \_\_\_\_\_

Job No. \_\_\_\_\_

Approx. No. of Cards 200

Operation Code \_\_\_\_\_

Machine Code 026

[illegible]

DISPOSITION OF CARDS:

Next Sheet No. \_\_\_\_\_

**Date Prepared** 3-21-63

FIG. A-4 PUNCHING AND VERIFICATION INSTRUCTIONS  
SHELTER MASTER CARD (Name and Address)

## PUNCHING AND VERIFICATION INSTRUCTIONS

CUSTOMER Civil Defense

REPORT TITLE Shelter Card Master Estimate No. \_\_\_\_\_

REPORT No. \_\_\_\_\_ Job No. \_\_\_\_\_

Approx. No. of Cards 200 Operation Code \_\_\_\_\_

Machine Code 026

NAME OF FIELD	COLUMNS		Number Columns	REMARKS
	From	Thru		
Card Code	1	-	1	"1" all cards.
Location Code	2	5	4	Precede with zeros.
Track No.	6	9	4	Precede with zeros.
Block No.	10	13	4	Precede with zeros.
Partial Code	14		1	Skip.
Shelter Number	15	19	5	Precede with zeros.
Protection Factor Category	20	21	2	Duplicate by groups.
Shelter Capacity	22	27	6	Precede with zeros.
Date Licensed	28	31	4	Skip.
Date Stocked	32	35	4	Skip.
Date Surveyed	43	46	4	Duplicate by groups.
Segment Number	76	77	2	Precede with zeros.
Partial Code	78	79	2	Precede with zeros.

DISPOSITION OF CARDS: \_\_\_\_\_

Next Sheet No. \_\_\_\_\_ Date Prepared 3-21-63

FIG. A-5 PUNCHING AND VERIFICATION INSTRUCTIONS  
SHELTER MASTER CARDS



## PUNCHING AND VERIFICATION INSTRUCTIONS

CUSTOMER Civil Defense

REPORT TITLE Block Detail Days and Nights Estimate No. \_\_\_\_\_

REPORT No. \_\_\_\_\_ Job No. \_\_\_\_\_

Approx. No. of Cards 2000 Operation Code 026

Machine Code \_\_\_\_\_

NAME OF FIELD	COLUMNS		Number Columns	REMARKS
	From	Thru		
Card Code	1	-	1	D or N.
Location Code	2	5	4	Precede with zeros.
Tract No.	6	9	4	Precede with zeros.
Block No.	10	13	4	Precede with zeros.
Partial Code	14	-	1	Punch "1" if marked Partial.
Shelter No.	15	19	5	Precede with zeros.
Protection Factor Category	20	21	2	Duplicate by Groups.
	22	35	14	Skip.
Population of Block Assigned	36	40	5	Precede with zeros.
Distance Code	41	42	2	"1" for unmarked. "2" for (1) "3" for (11)
Date Surveyed	43	46	4	Duplicate by Groups.
Segment	76	77	2	Precede with zeros.

DISPOSITION OF CARDS: \_\_\_\_\_

Next Sheet No. \_\_\_\_\_ Date Prepared 3-21-63

FIG. A-6 PUNCHING AND VERIFICATION INSTRUCTIONS  
BLOCK DETAIL DAYS AND NIGHTS

## PUNCHING AND VERIFICATION INSTRUCTIONS

<b>CUSTOMER</b>	<u>Civil Defense</u>	
<b>REPORT TITLE</b>	<u>Unassigned Blocks</u>	<b>Estimate No.</b> _____
<b>REPORT No.</b>	<u>600</u>	<b>Job No.</b> _____
<b>Approx. No. of Cards</b>	_____	<b>Operation Code</b> _____
		<b>Machine Code</b> 026

[illegible]

DISPOSITION OF CARDS: \_\_\_\_\_  
 Next Sheet No. \_\_\_\_\_ Date Prepared 3-21-63

**FIG. A-7 PUNCHING AND VERIFICATION INSTRUCTIONS UNASSIGNED BLOCKS**

CLIENT	ANY CITY	DATE	3-16-63
ADDRESS	ANY STATE	JOB DESCRIPTION	

[illegible]

FIG. A-8 MULTIPLE CARD FORM SHOWING CARD LAYOUTS

of punched cards. These six (6) decks are numbered 1 through 6 on the Multiple Card Form and are respectively labeled as follows:

- (1) Shelter Master
- (2) Block Detail for Nighttime Assignments
- (3) Block Detail for Daytime Assignments
- (4) Shelter Masters with name and address
- (5) Block Detail for the Unassigned Nighttime Blocks
- (6) Block Detail for the Unassigned Daytime Blocks.

As many columns as possible in all cards were designed with common fields of information, as the Multiple Card Form indicates. These card decks were designed in this manner so as to: (1) assure the appropriate matching and merging of cards, (2) facilitate the job of key-punching and handling the cards, and (3) reduce the data processing costs.

As will be noted in the Multiple Card Form, Columns 1 through 13 possessed fields that were common to all cards. These spaces were filled by codes describing the day and night assignments, the Standard Location number, the Census Tract Number, and the Census Block Number. Column 14 was skipped in all cards, with the exception of in the Assigned Block Detail Cards wherein a resident population code number was introduced. In Cards 1 through 4, the shelter and block cards, Columns 15 through 19 were reserved for a Shelter Number, and Columns 20 and 21 contained a Protection Factor code. In Card 1, the Shelter Master, Columns 22 through 35 were divided into Shelter Capacity, Date Licensed, and Date Stocked. In Cards 1, 2, and 3, the Shelter Master and Block Detail cards, Columns 43 through 46 were reserved for the Data Surveyed. Columns 76 and 77 were marked with a segment code in all Cards, with the exception of the Shelter Master Address Card, card number 4. All Block Detail Cards devoted Columns 36 through 40 to either nighttime or daytime population data. The distance code in Columns 41 and 42 was common to both the nighttime and daytime block cards, card numbers 1 and 2. In the Shelter Master (Address Card), card number 4, columns 22 through 80 were reserved for the name and address of the specific shelter. In the

Shelter Master, card number 1, Columns 78 and 79 were used to record the Partial Block Code. All other columns in the cards were unassigned.

#### 4. Flow Charts of Procedures

Before the cards were key punched, Flow Charts were developed which described the operations and procedures to be performed in order that various shelter assignment reports could be generated. Figures A-9 through A-16 describe eight Flow Charts that report on the Procedures to be used in producing the following reports:

- (1) Shelter Name and Address List
- (2) Listing of all Assigned and Unassigned Blocks
- (3) Shelter Assignments with Ample Warning Time
- (4) Shelter Assignments with One Hour Warning
- (5) Shelter Assignments with Thirty Minute Warning
- (6) Unassigned Blocks with Ample Warning Time
- (7) Unassigned Blocks with One Hour Warning Time
- (8) Unassigned Blocks with Thirty Minutes Warning.

These Flow Charts (or Procedure Diagrams) serve to report the sequence in which the cards are to be punched, verified, sorted, collated, and listed.

#### 5. Specifications for Wiring the Control Panels

The most complicated and expensive task performed in utilizing the data-processing equipment for a shelter assignment was found in the wiring of two printer control panels. A printer control panel with wiring is shown in Fig. A-3 of the main text.

Figure A-17 shows the Planning Chart used in wiring the printer panel for the Shelter Name and Address Listing, Report Number 1 and Procedure Number 1. The Control Panel Diagram is shown in Fig. A-18. The Planning Chart used in wiring the printer panel for Reports 2 through 8 (and Procedures 2 through 8) is depicted in Fig. A-19.

The instructions for wiring the collator panel required in Procedure Number 3 (or Report Number 3) are summarized under Fig. A-20.

# NAME & ADDRESS LISTING

## PROCEDURE NO. 1

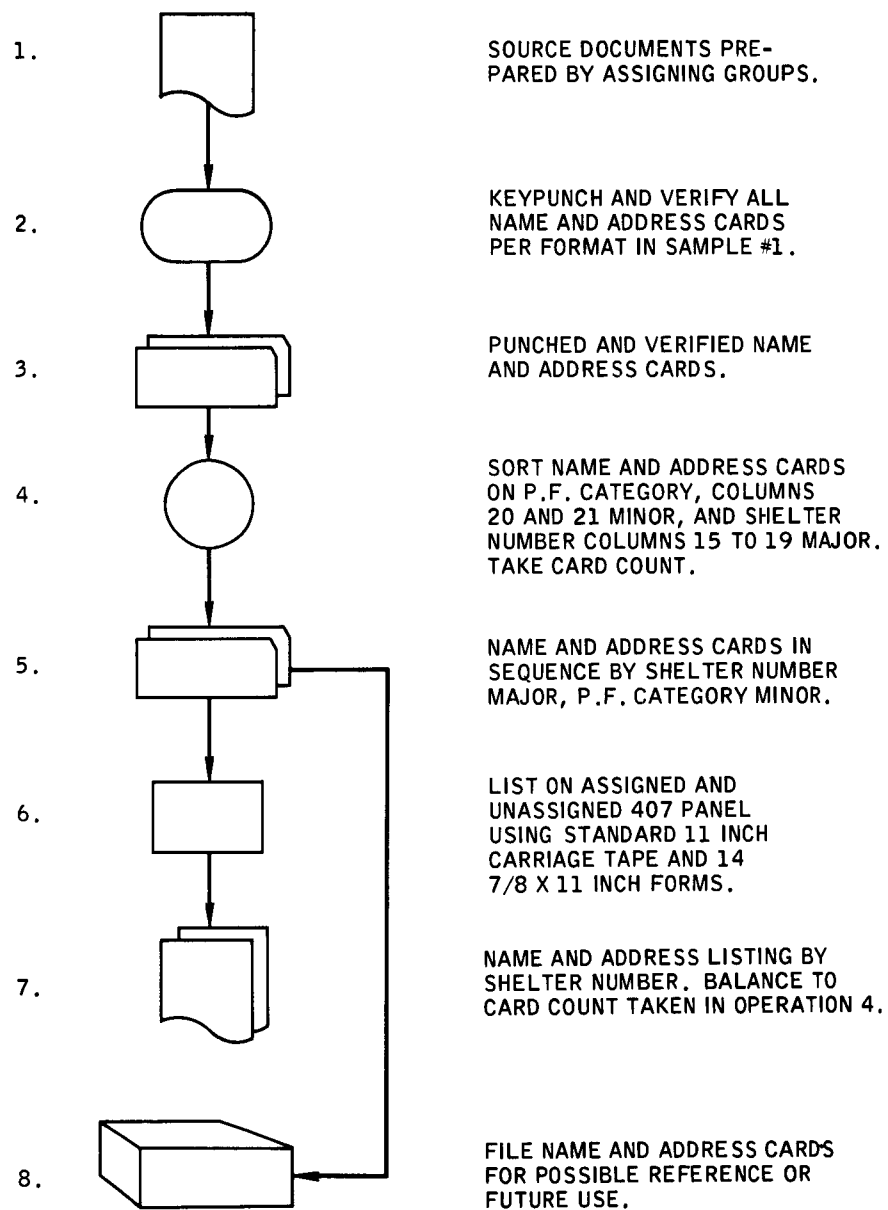


FIG. A-9 NAME AND ADDRESS LISTING - PROCEDURE NO. 1

# ASSIGNED & UNASSIGNED BLOCKS

## PROCEDURE NO. 2

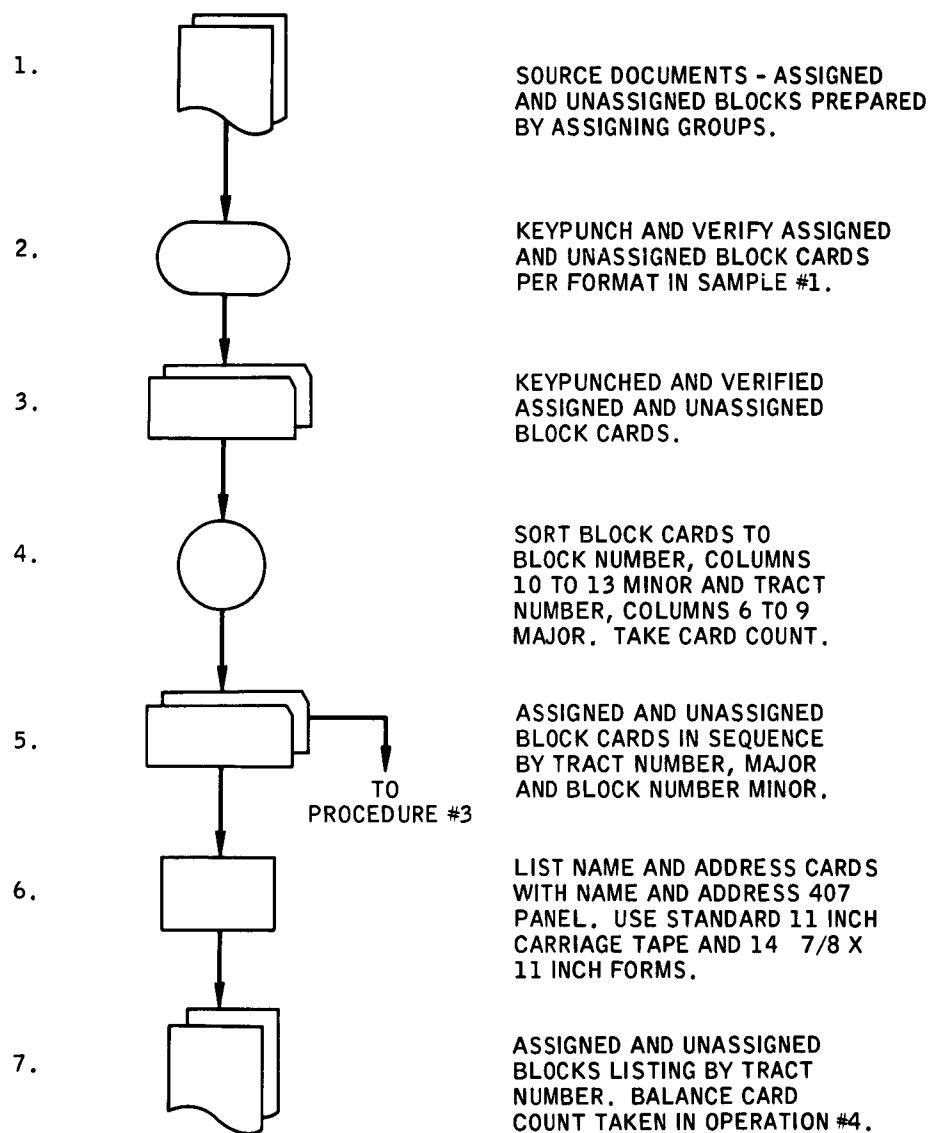


FIG. A-10 ASSIGNED AND UNASSIGNED BLOCKS - PROCEDURE NO. 2

# SHELTER ASSIGNMENTS (AMPLE WARNING TIME)

## PROCEDURE NO. 3

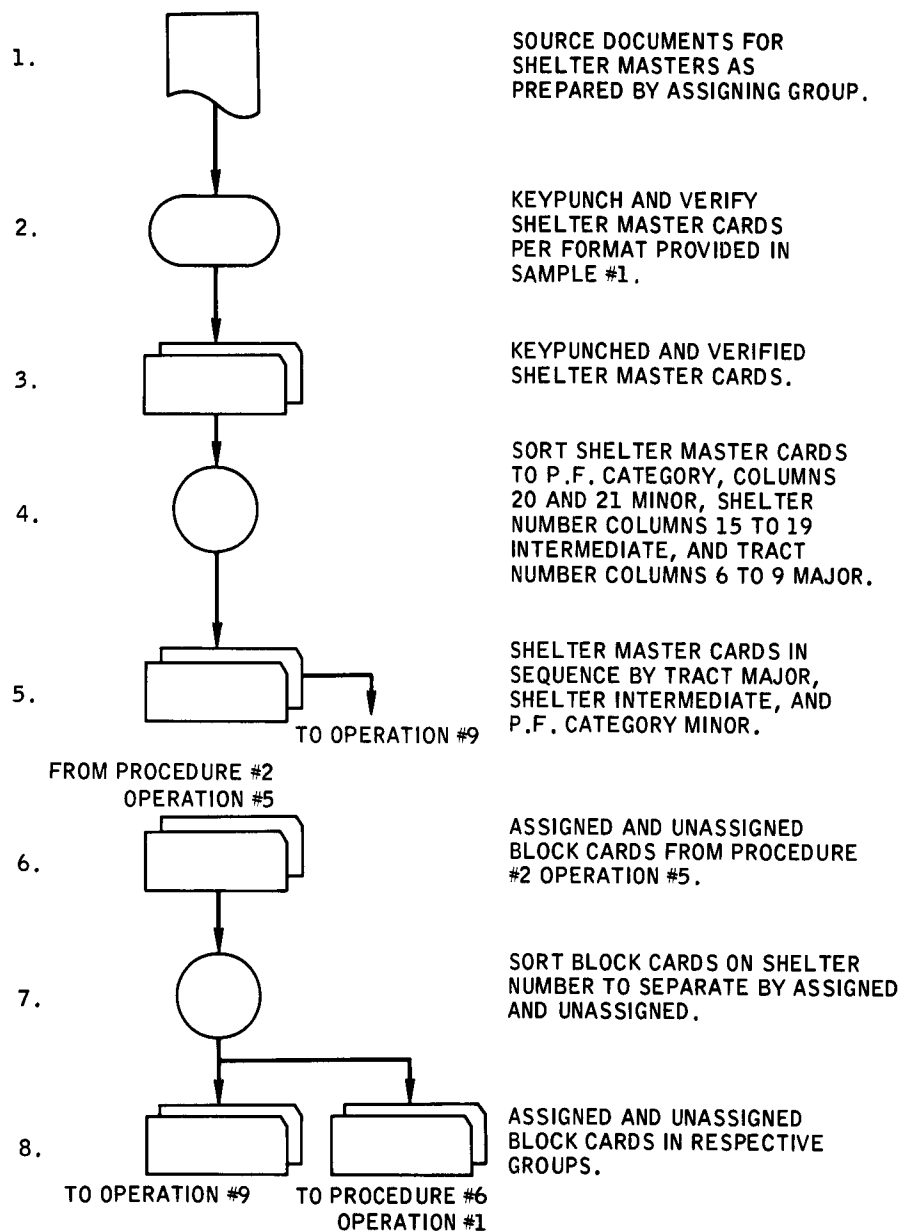


FIG. A-11 SHELTER ASSIGNMENTS (ample warning time) - PROCEDURE NO. 3



# SHELTER ASSIGNMENTS (AMPLE WARNING TIME)

## PROCEDURE NO. 3 (CONTINUED)

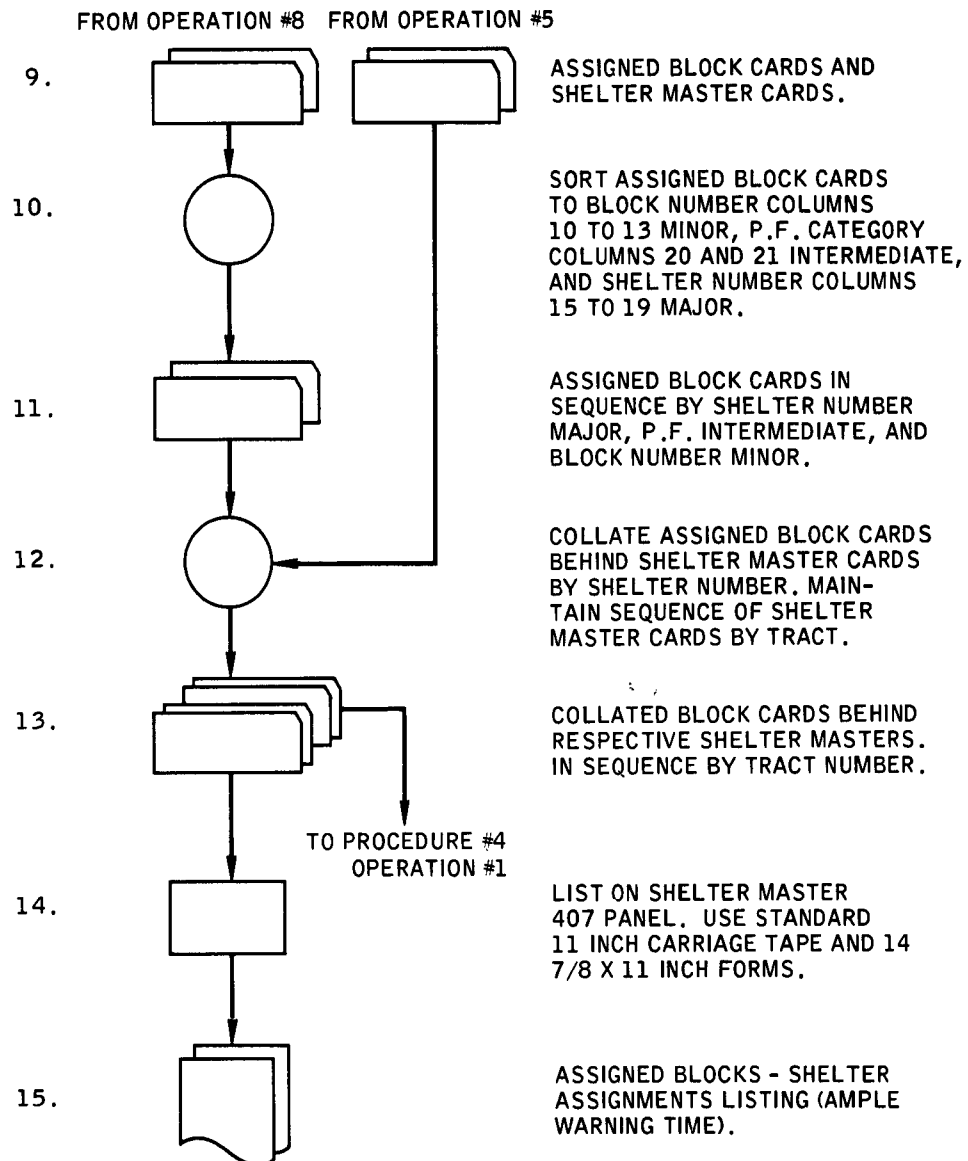


FIG. A-11 continued

# SHELTER ASSIGNMENTS (ONE-HOUR WARNING)

## PROCEDURE NO. 4

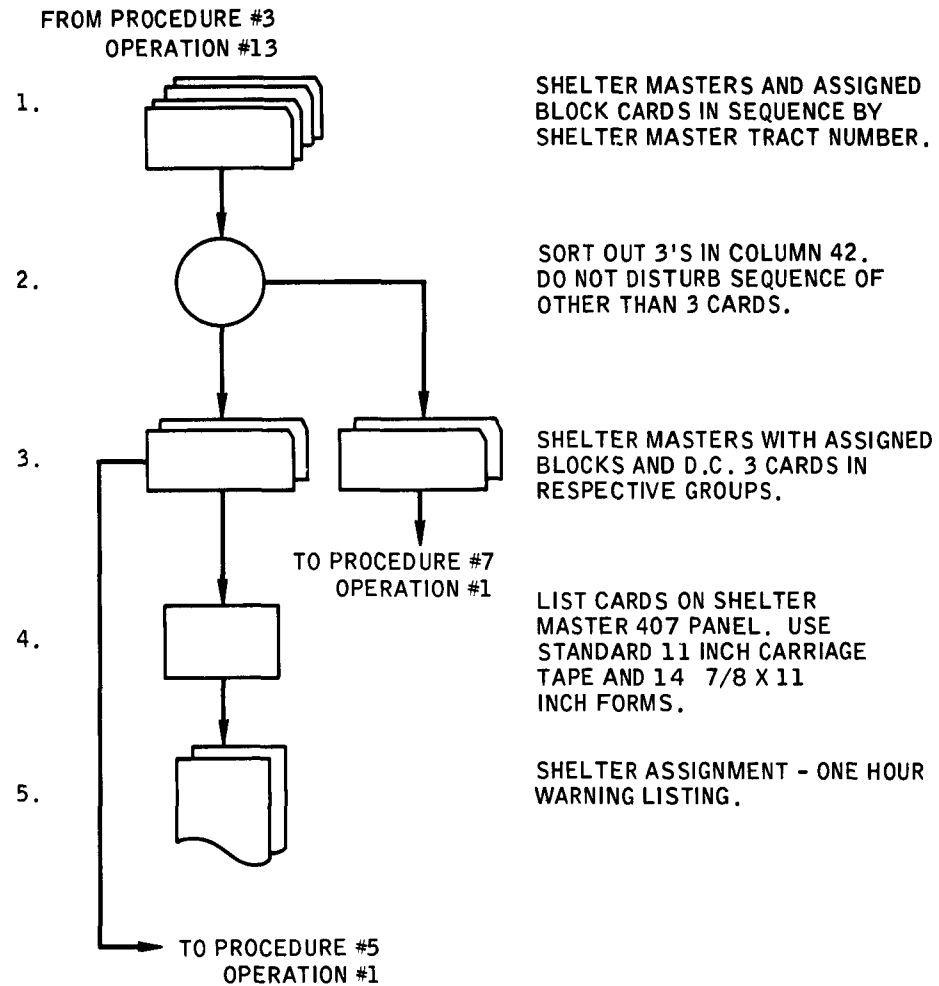


FIG. A-12 SHELTER ASSIGNMENTS (one hour warning) - PROCEDURE NO. 4

# SHELTER ASSIGNMENTS (30 MINUTE WARNING)

## PROCEDURE NO. 5

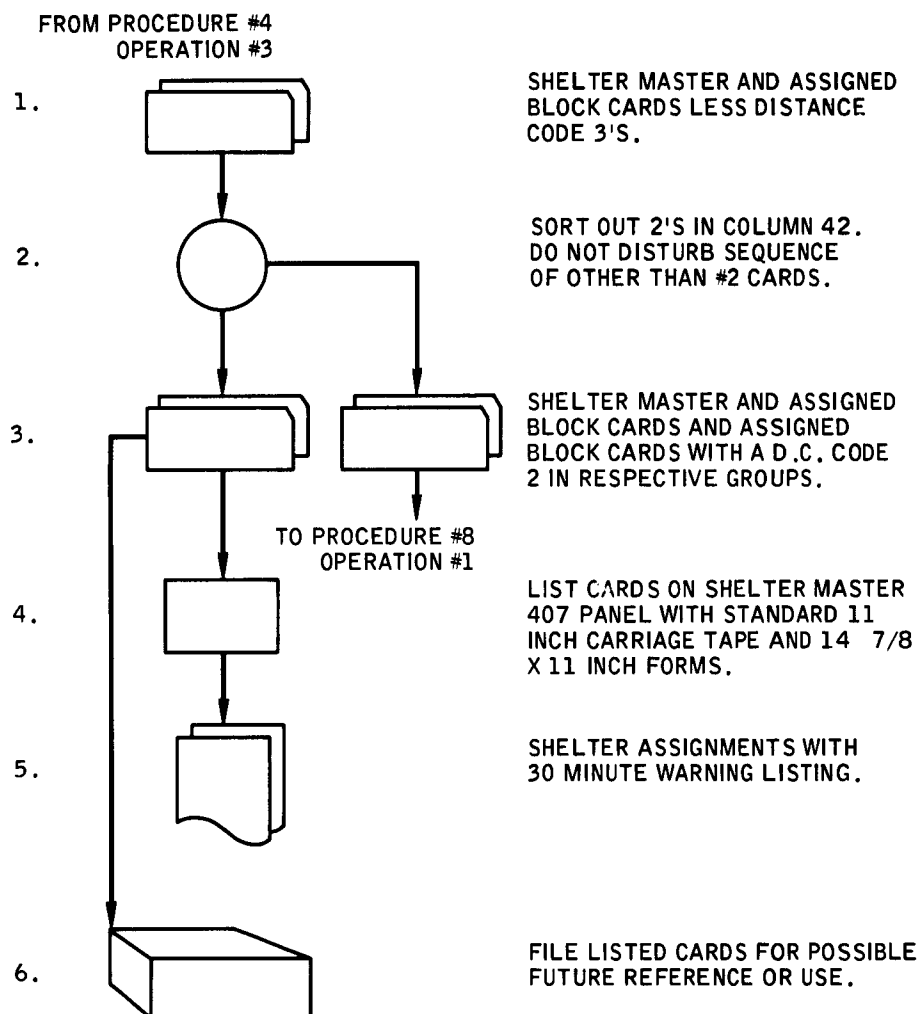


FIG. A-13 SHELTER ASSIGNMENTS (30 minute warning) - PROCEDURE NO. 5

# UNASSIGNED BLOCKS (AMPLE WARNING TIME)

## PROCEDURE NO. 6

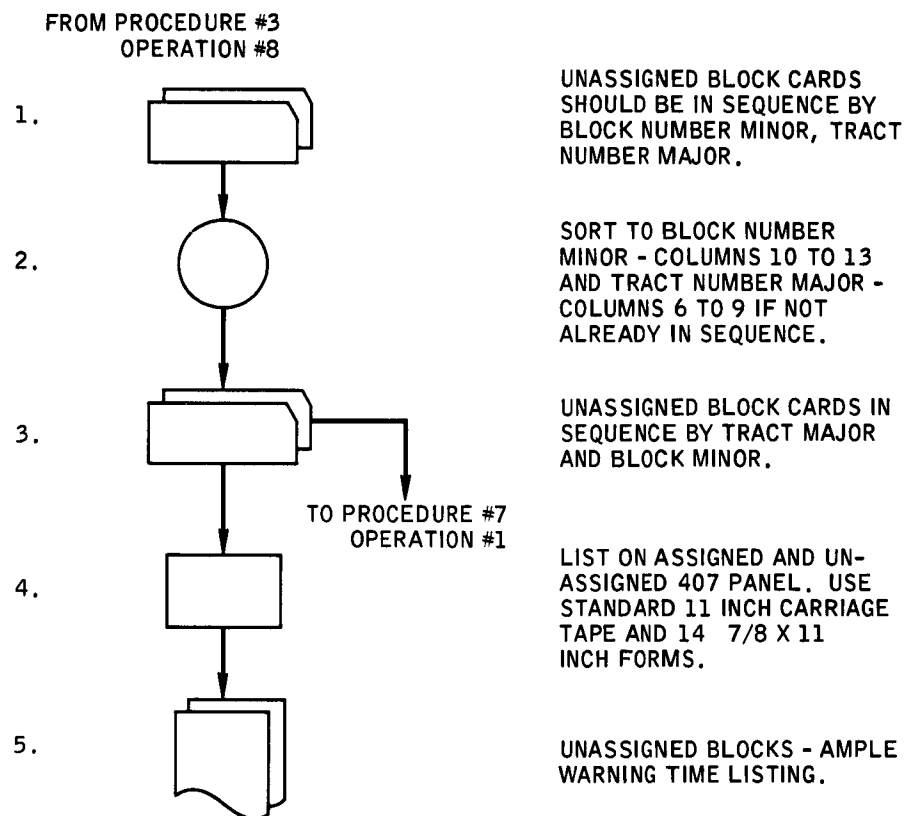


FIG. A-14 UNASSIGNED BLOCKS (ample warning time) - PROCEDURE NO. 6

# UNASSIGNED BLOCKS (ONE-HOUR WARNING)

## PROCEDURE NO. 7

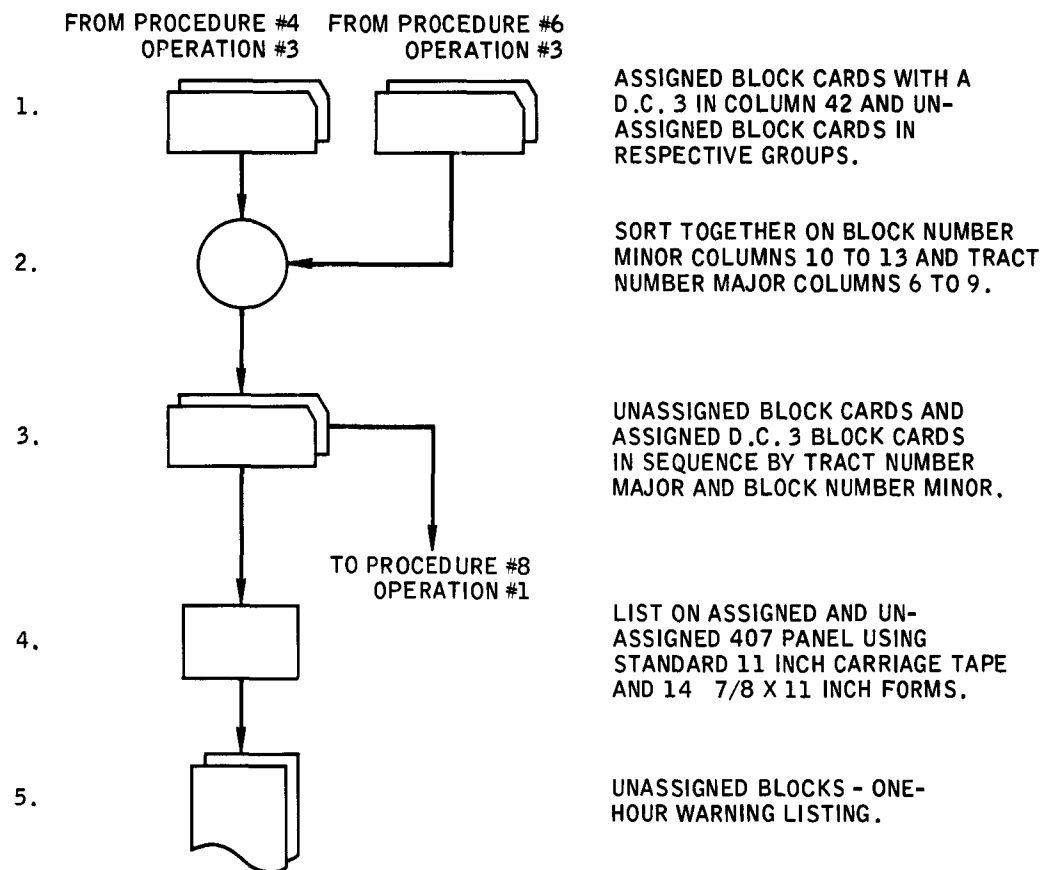


FIG. A-15 UNASSIGNED BLOCKS (one hour warning) - PROCEDURE NO. 7

# UNASSIGNED BLOCKS (30 MINUTES WARNING)

## PROCEDURE NO. 8

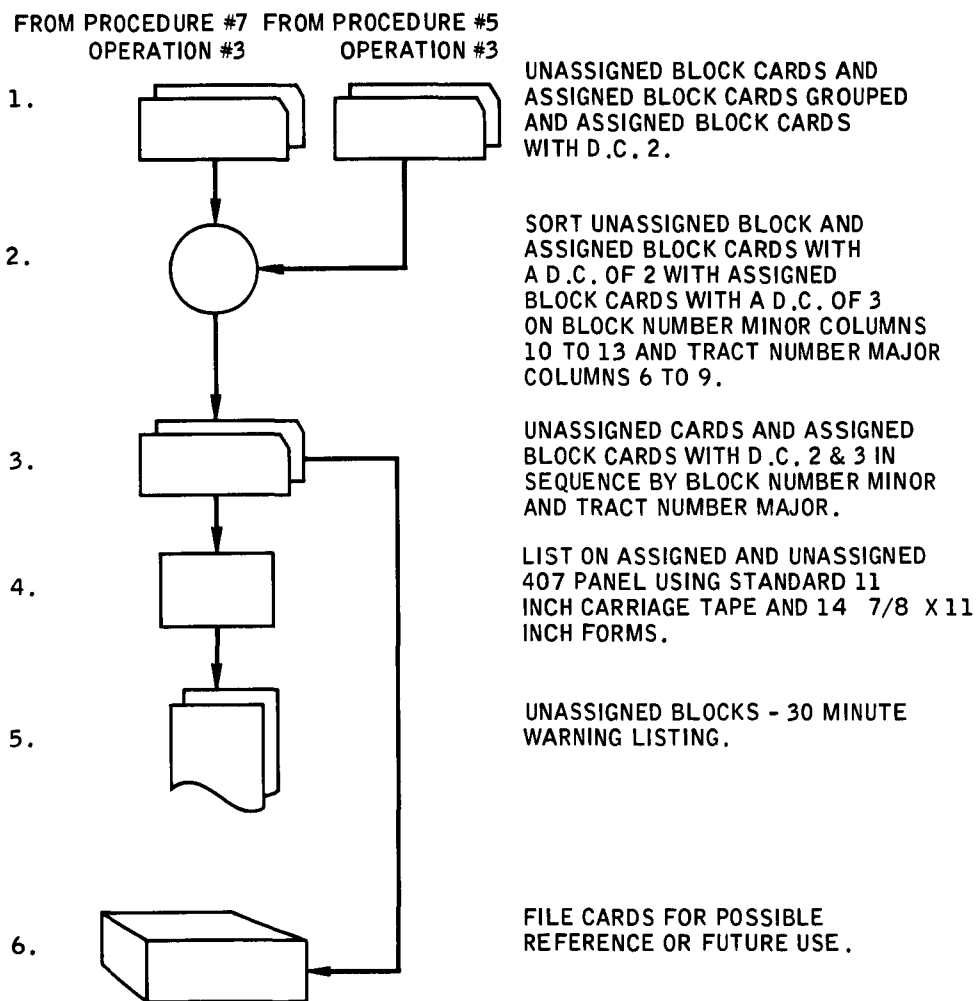


FIG. A-16 UNASSIGNED BLOCKS (30 minute warning) - PROCEDURE NO. 8

# PLANNING CHART

REPORT

2. Assign
4. Shelter
6. Unassi
8. Unassi

CONTROL PANEL SWITCHES				SPACE		CONTROL		TAPE CHANNELS (TAPE CUT ON LINE 132)				
LIST	OFF <input type="checkbox"/>	SP SW	ON <input type="checkbox"/>	1	<input checked="" type="checkbox"/>	HEAD	<input type="checkbox"/>	NO	USE	LINES	NO	USE
RO	ON <input type="checkbox"/>	SYMBOL	R <input checked="" type="checkbox"/>	2	<input type="checkbox"/>	SKIP	<input type="checkbox"/>	(Standard 11 inch carriage tape)				
LCT	ON <input checked="" type="checkbox"/>	LC SK	ON <input type="checkbox"/>	EX	<input checked="" type="checkbox"/>	TR PR	<input checked="" type="checkbox"/>					
SPL PRG	ON <input type="checkbox"/>	CAR	ON <input type="checkbox"/>	SUP	<input type="checkbox"/>	SP PU	<input type="checkbox"/>					
		SP-C	ON <input type="checkbox"/>	SEL	<input type="checkbox"/>							
				LINES	<input checked="" type="checkbox"/>							

REPORT HEADINGS		LOC. CODE	TRACT NO.	BLOCK NO.	P	SHELTER NUMBER	PF	SHELTER CAPACITY	DATE LICENSED	DATE STOCKED	
CARD COLUMNS		1	2-5	6-9	10-13	14	15-19	20-21	22-27	28-31	32-35
EMITTED CHARACTERS		***									
PRINT ENTRY	TRANSFER	4-7	8-12	15-19	22	25-31	34-35	38-45	48-55	58-64	
	NORMAL	1/3	4-7	8-11	15-18	22	25-29	34-35	41 45-47		
	COUNTER-CONTROLLED	38-40 42-44									
ZERO PRINT CONTROL		1-11	16-22		25-29	34-35	38-47				
PRINT CONTROL		Transfer print on steps 2 and 3 of Overflow Program.								Wire all rep	
PROGRAM CONTROL		min. (unassigned lists)				int. (assigned lists)		min. Start Overflow Program on x-80 header card		Start Overfl from 12 punch	
COUNTERS	1 MINOR	GROUP	6A								
		CONTROL	+ on a "1" in col. 1								
	2 INTER.	GROUP	6C								
		CONTROL	+ transfer from 6A								
	3 MAJOR	GROUP									
		CONTROL									
	4 FINAL	GROUP	6E								
		CONTROL	+ transfer from 6C								
	5	GROUP									
		CONTROL									
STORAGE	UNIT	A, B & C									
	CONTROL	IN	X in column 80 (11 punch) from first reading station. (header card)								
		OUT	During Overflow Program step 3 and step 2.								
SUMMARY PUNCH CARD COLUMNS											
SELECTORS	NO.	PU	NO.	PU	NO.	PU	NO.	PU	NO.	PU	
	T		T		T		T		T		
	N		N		N		N		N		
	C		C		C		C		C		
MISCELLANEOUS		Punch heading information in header card.									
CARDS USED		Shelter Master Cards, Assigned Blocks, and Unassigned Blocks									

FIG. A-19 TABULATOR-PRINTER PL







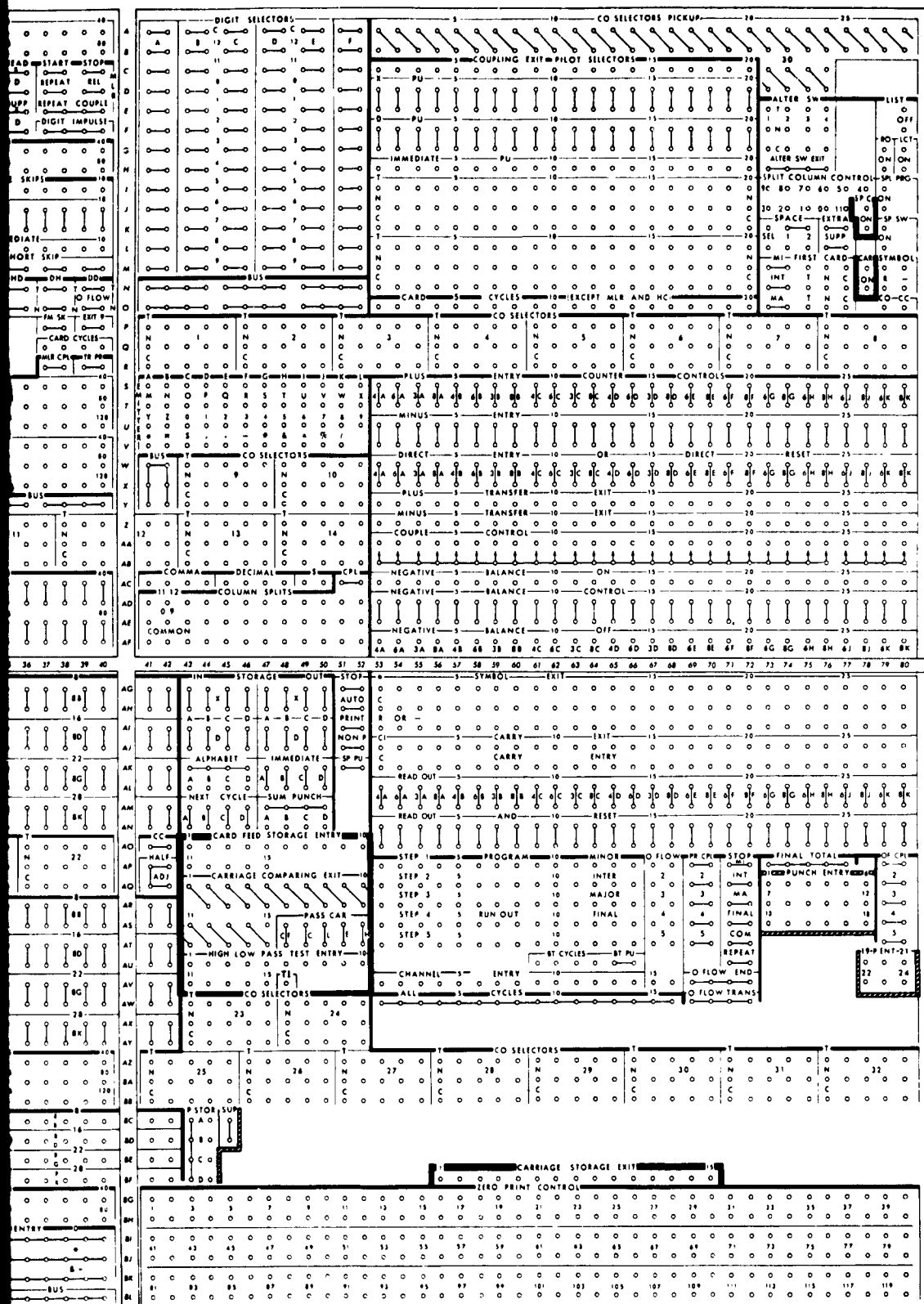
The diagram illustrates the internal wiring and control logic of the IBM 604 Card Punch Control Unit. It is organized into several main functional blocks:

- First Reading:** Includes sections for comparing entry and exit, and second reading.
- Progressive Selectors:** Controls for line 1, line 2, line 3, and common.
- Storage:** Includes storage entry and storage exit for Unit A, Unit C, and Unit D.
- Transfer Print:** Transfer print entry and exit.
- Normal Print:** Normal print entry and exit.
- Counter:** Counter entry and exit, counter controlled print, and counter punch exit.
- Summary Punch:** Summary punch entry and exit.
- Storage Punch:** Storage punch entry and exit.
- Control and Select Lines:** Includes various select lines (e.g., SELECT, SKIP, IMMEDIATE, SHORT SKIP, BUS, CTRL, FM SK, EXIT, P, M, L, R, C, N, O, T, F, W, X, Y, Z, AA, AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK, AL, AM, AN, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, AZ, BA, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BL, BM, BN, BO, BP, BQ, BR, BS, BT, BU, BV, BW, BX, BY, BZ, CA, CB, CC, CD, CE, CF, CG, CH, CI, CJ, CK, CL, CM, CN, CO, CP, CQ, CR, CS, CT, CU, CV, CW, CX, CY, CZ, DA, DB, DC, DD, DE, DF, DG, DH, DI, DJ, DK, DL, DM, DN, DO, DP, DQ, DR, DS, DT, DU, DV, DW, DX, DY, DZ, EA, EB, EC, ED, EE, EF, EG, EH, EI, EJ, EK, EL, EM, EN, EO, EP, EQ, ER, ES, ET, EU, EV, EW, EX, EY, EZ, FA, FB, FC, FD, FE, FF, FG, FH, FI, FJ, FK, FL, FM, FN, FO, FP, FQ, FR, FS, FT, FU, FV, FW, FX, FY, FZ, GA, GB, GC, GD, GE, GF, GG, GH, GI, GJ, GK, GL, GM, GN, GO, GP, GQ, GR, GS, GT, GU, GV, GW, GX, GY, GZ, HA, HB, HC, HD, HE, HF, HG, HH, HI, HJ, HK, HL, HM, HN, HO, HP, HQ, HR, HS, HT, HU, HV, HW, HX, HY, HZ, IA, IB, IC, ID, IE, IF, IG, IH, II, IJ, IK, IL, IM, IN, IO, IP, IQ, IR, IS, IT, IU, IV, IW, IX, IY, IZ, JA, JB, JC, JD, JE, JF, JG, JH, JI, JJ, JK, JL, JM, JN, JO, JP, JQ, JR, JS, JT, JU, JV, JW, JX, JY, JZ, KA, KB, KC, KD, KE, KF, KG, KH, KI, KJ, KK, KL, KM, KN, KO, KP, KQ, KR, KS, KT, KU, KV, KW, KX, KY, KZ, LA, LB, LC, LD, LE, LF, LG, LH, LI, LJ, LK, LL, LM, LN, LO, LP, LQ, LR, LS, LT, LU, LV, LW, LX, LY, LZ, MA, MB, MC, MD, ME, MF, MG, MH, MI, MJ, MK, ML, MM, MN, MO, MP, MQ, MR, MS, MT, MU, MV, MW, MX, MY, MZ, NA, NB, NC, ND, NE, NF, NG, NH, NI, NJ, NK, NL, NM, NO, NP, NQ, NR, NS, NT, NU, NV, NW, NX, NY, NZ, OA, OB, OC, OD, OE, OF, OG, OH, OI, OJ, OK, OL, OM, ON, OO, OP, OQ, OR, OS, OT, OU, OV, OW, OX, OY, OZ, PA, PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PM, PN, PO, PP, PQ, PR, PS, PT, PU, PV, PW, PX, PY, PZ, QA, QB, QC, QD, QE, QF, QG, QH, QI, QJ, QK, QL, QM, QN, QO, QP, QQ, QR, QS, QT, QU, QV, QW, QX, QY, QZ, RA, RB, RC, RD, RE, RF, RG, RH, RI, RJ, RK, RL, RM, RN, RO, RP, RQ, RR, RS, RT, RU, RV, RW, RX, RY, RZ, SA, SB, SC, SD, SE, SF, SG, SH, SI, SJ, SK, SL, SM, SN, SO, SP, SQ, SR, SS, ST, SU, SV, SW, SX, SY, SZ, TA, TB, TC, TD, TE, TF, TG, TH, TI, TJ, TK, TL, TM, TN, TO, TP, TQ, TR, TS, TT, TU, TV, TW, TX, TY, TZ, UA, UB, UC, UD, UE, UF, UG, UH, UI, UJ, UK, UL, UM, UN, UO, UP, UQ, UR, US, UT, UY, UZ, VA, VB, VC, VD, VE, VF, VG, VH, VI, VJ, VK, VL, VM, VN, VO, VP, VQ, VR, VS, VT, VU, VV, VW, VX, VY, VZ, WA, WB, WC, WD, WE, WF, WG, WH, WI, WJ, WK, WL, WM, WN, WO, WP, WQ, WR, WS, WT, WU, WV, WW, WX, WY, WZ, XA, XB, XC, XD, XE, XF, XG, XH, XI, XJ, XK, XL, XM, XN, XO, XP, XQ, XR, XS, XT, XU, XV, XW, XX, XY, XZ, YA, YB, YC, YD, YE, YF, YG, YH, YI, YJ, YK, YL, YM, YN, YO, YP, YQ, YR, YS, YT, YU, YV, YW, YX, YY, YZ, ZA, ZB, ZC, ZD, ZE, ZF, ZG, ZH, ZI, ZJ, ZK, ZL, ZM, ZN, ZO, ZP, ZQ, ZR, ZS, ZT, ZU, ZV, ZW, ZX, ZY, ZZ.

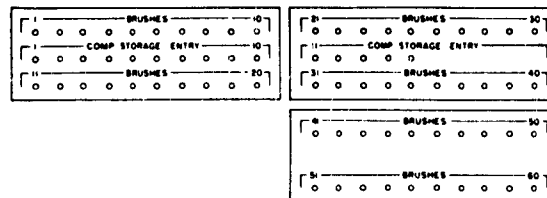
A large number '1' is visible in the bottom right corner of the diagram.

FIG. A-18 BASIC REL

# COUNTING MACHINES, CONTROL PANEL DIAGRAM



## FIXED CARRIAGE CONTROL PANEL



REPORT \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

DIAGRAM NO. \_\_\_\_\_

DATE \_\_\_\_\_

FIG. A-18 BASIC CONTROL PANEL DIAGRAM

# PLANNING CHART

REPORT \_\_\_\_\_ Report No. \_\_\_\_\_

CONTROL PANEL SWITCHES		SPACE		CONTROL		TAPE CHANNELS (TAPE CUT ON LINE <u>132</u> )						
LIST	OFF <input type="checkbox"/>	SP SW	ON <input type="checkbox"/>	1	<input type="checkbox"/>	HEAD	<input type="checkbox"/>	NO	USE	LINES	NO	USE
RO	ON <input type="checkbox"/>	SYMBOL	R <input type="checkbox"/>	2	<input checked="" type="checkbox"/>	SKIP	<input type="checkbox"/>					
LCT	ON <input checked="" type="checkbox"/>	LC SK	ON <input type="checkbox"/>	EX	<input type="checkbox"/>	MLR	<input type="checkbox"/>					
SPL PRG	ON <input type="checkbox"/>	CAR	ON <input type="checkbox"/>	SUP	<input type="checkbox"/>	TR PR	<input checked="" type="checkbox"/>	(use standard 11 inch carriage tape)				
		SP-C	ON <input type="checkbox"/>	SEL	<input type="checkbox"/>	SP PU	<input type="checkbox"/>					
				LINES	6 <input checked="" type="checkbox"/> 8 <input type="checkbox"/>							

REPORT HEADINGS		LOC. CODE	TRACT NO.	BLOCK NO.	P	SHELTER NUMBER	PF	R	NAME AND ADDRESS OF SHELTER	
CARD COLUMNS		1	2-5	6-9	10-13	14	15-19	20-21 22	23-80	
EMITTED CHARACTERS										
PRINT ENTRY	TRANSFER	4-7	8-12	16-20	25	29-35	39-40 44	48-74		
	NORMAL	1	4-7	8-11	16-19	25	30-34	39-40 44	48-105	
	COUNTER-CONTROLLED									
ZERO PRINT CONTROL		1-11	16-25	30-44	48-105					
PRINT CONTROL		Transfer Print on steps 2 and 3 during Overflow Program.								
PROGRAM CONTROL		Start an Overflow Program with an X-80 header card and on a 12 in tape/ (Shel								
COUNTERS	1 MINOR	GROUP								
		CONTROL								
	2 INTER.	GROUP								
		CONTROL								
	3 MAJOR	GROUP								
		CONTROL								
	4 FINAL	GROUP								
		CONTROL								
	5	GROUP								
		CONTROL								
STORAGE	UNIT	A, B & C								
	CONTROL	IN	X in column 80 (11 punch) from first reading station.							
		OUT	on step 2 and step 3 of Overflow Program.							
SUMMARY PUNCH CARD COLUMNS										
SELECTORS	NO.	PU	NO.	PU	NO.	PU	NO.	PU	NO.	PU
	T		T		T		T		T	
	N		N		N		N		N	
	C		C		C		C		C	
MISCELLANEOUS		Punch heading information in header card.								
CARDS USED		Name and Address Master Cards Only.								

FIG. A-17 TABULATOR-PRINT

1

# REPORT Report No. 1 - Name And Address Listing

TAPE CHANNELS (TAPE CUT ON LINE 132)

LINES	NO	USE	LINES

11 inch carriage tape)

## CARRIAGE SKIP CONTROL

HH-T		DH-N	
HH-N		DD-T	
HD-T		O'FLOW	X
HD-N		EXIT 9	
DH-T		EJECT	D
			I

## ALTERATION SWITCHES

	1	2	3	4
T				
N				
C				

## TOGGLE SWITCHES

	ON
INVERTED	<input type="checkbox"/>
FINAL TOTAL	<input checked="" type="checkbox"/>
FORM STOP	<input checked="" type="checkbox"/>
RESET CHECK	<input checked="" type="checkbox"/>

NAME AND ADDRESS OF SHELTER

23-80

48-74

48-105

108-111

48-105

108-111

am.

and on a 12 in tape/

(Shelter Count)

4A

+ 1 on a "2"  
in column 1.

STORAGE UNITS ASSIGNED TO 409 PUNCH

409 PUNCHED CARD COLUMNS

NO.	PU	NO.	PU	NO.	PU	NO.	PU	NO.	PU	NO.	PU
T		T		T		T		T		T	
N		N		N		N		N		N	
C		C		C		C		C		C	

INSTRUCTIONS FOR WIRING COLLATOR PANEL  
REQUIRED IN PROCEDURE NO. 3  
(077 - 085 - 087 - 089 Type)

1. Shelter Master cards should be in sequence by Tract No. - Major  
Shelter No. - Minor
2. Assigned Block cards should be in sequence by Shelter No. - Major  
PF Code - Intermediate  
Block No. - Minor
3. Wire panel as follows:  
All basic setup switches wired on.  
Secondary Read columns 15-19 to Secondary Selector Entries 1-5.  
Primary Read columns 15-19 to Primary Selector Entries 1-5.  
Primary Sequence Read columns 15-19 to Primary Sequence Entries 1-5.  
Wire Primary Selector Entries 1-5 to Primary Sequence Selector Entries 1-5.  
Wire Low Primary Sequence to Error Stop.  
Wire Low Secondary to Pocket 3 Select.  
Wire Low Primary to Pocket 1 Select.
4. Place Shelter Masters - one tract at a time - in the Primary Feed.
5. Place all Assigned Block cards in the Secondary Feed.
6. After each run is complete place the cards in Pocket 2 - keeping them in sequence - in a tray ready to be listed.
7. The cards in Pocket 3 will then go back in the Secondary Feed to be matched against the next group of Shelter Masters, ie Tract No. 0002.
8. There should be no cards in Pocket 2. (if so that means there is a Shelter Master with no Block cards assigned to that shelter)
9. Repeat this operation until last group of Shelter Masters is matched out with remaining Assigned Block cards. (listing can now be run)

FIG. A-20 INSTRUCTIONS FOR WIRING COLLATOR PANEL - PROCEDURE NO. 3

#### 6. Time Analyses by Operation

A total of approximately 63 man-hours were required to process the cards and operate the data processing equipment in order to produce the Shelter Name and Address Listing report plus the seven reports describing the nighttime assignment. These eight reports (or procedures) along with the times required are itemized in Fig. A-21. The hours recorded included some experimental work necessary in order to work out the "bugs" that was not repeated in the daytime assignment reports. For example, the 40 hours recorded under Procedure 2 for key punching and verifying the 2700 nighttime block detail cards were reduced to 27 hours for key punching and verifying the same number of daytime block detail cards. Procedures 3 through 8 required about the same number of hours for both the nighttime and daytime assignments.

#### 7. Cost Analyses

Approximately \$900 was required per order to contract the data-processing portion of producing fourteen reports pertaining to shelter assignment in Lincoln, Nebraska (see Fig. A-22). The \$900 cost was broken down as follows:

- (1) \$450 for providing eight (8) nighttime reports including the Shelter Name and Address list.
- (2) \$329 for completing seven (7) daytime reports.
- (3) \$122 for wiring the Printer Control Panels.

As shown in Figure A-22, a considerable reduction in cost occurred for producing the daytime reports 2 and 3 as compared to the nighttime reports 2 and 3. It is noted that the combined costs of producing these reports was \$275 for the nighttime as compared to \$194 for the daytime. As mentioned in Sec. 6 above, these reductions were realized in the daytime reports as a result of procedure refinements discovered in producing the nighttime reports.

The data-processing costs itemized in Fig. A-22 are characteristic of those costs that could be expected in key punching and processing Shelter Assignment cards for a city of about 129,000 resident population,

similar to Lincoln, Nebraska. Lincoln contains about 2700 Census Blocks and 180 shelters (pf Category of 2 or greater) located in 147 separate buildings.

In all, a total of about 5800 cards were key punched and processed.

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TIME ANALYSIS BY OPERATION

1.	Procedure No. 1 - <u>Name and Address Listing</u>		
A.	Keypunch and Verify:		
	Approximately 200 Shelter Name and Address Cards		5.0 Hours
B.	Sorting		.3 Hours
C.	Listing		
	*Set-Up	.1	
	Running	<u>.3</u>	
			<u>.4 Hours</u>
			5.7 Hours
2.	Procedure No. 2 - <u>Assigned and Unassigned Blocks</u>		
A.	Keypunch and Verify:		
	Approximately 2000 Assigned Cards		
	700 Unassigned		
			40.0 Hours
B.	Sorting		.8 Hours
C.	Listing		
	*Set-Up	.1	
	Running	<u>1.0</u>	
			<u>1.1 Hours</u>
	Using Wired Control Panel		41.9 Hours
3.	Procedure No. 3 - <u>Shelter Assignments</u> (Ample Warning Time)		
A.	Keypunch and Verify Shelter Masters:		
	Approximately 200 cards		5.0 Hours
B.	Sorting		1.5 Hours
	Collating		2.5 Hours
	Listing		
	*Set-Up	.1	
	Running	<u>1.0</u>	
			<u>1.1 Hours</u>
			10.1 Hours

\*Using Wired Control Panel

FIG. A-21 TIME ANALYSIS BY OPERATION



4.	Procedure No. 4 - <u>Shelter Assignment</u> (One hour Warning)		
	A. Sorting		.3 Hours
	B. Listing		
	*Set-Up	.1	
	Running	.8	
			<u>.9 Hours</u>
			1.2 Hours
5.	Procedure No. 5 - <u>Shelter Assignment</u> (30 Minute Warning)		
	A. Sorting		.2 Hours
	B. Listing		
	*Set-Up	.1	
	Running	.8	
			<u>.9 Hours</u>
			1.1 Hours
6.	Procedure No. 6 - <u>Unassigned Blocks</u> (Ample Warning Time)		
	A. Sorting		.5 Hours
	B. Listing		
	*Set-Up	.1	
	Running	.4	
			<u>.5 Hours</u>
			1.0 Hours
7.	Procedure No. 7 - <u>Unassigned Blocks</u> (One Hour Warning)		
	A. Sorting		.5 Hours
	B. Listing		
	*Set-Up	.1	
	Running	.5	
			<u>.6 Hours</u>
			1.1 Hours
8.	Procedure No. 8 - <u>Unassigned Blocks</u> (30 Minute Warning)		
	A. Sorting		.5 Hours
	B. Listing		
	*Set-Up	.1	
	Running	.5	
			<u>.6 Hours</u>
			1.1 Hours

Allow approximately five hours handling time (clerical).

\*Using Wired Control Panel

FIG. A-21 continued

DATA PROCESSING COSTS  
SHELTER ASSIGNMENT REPORTS  
LINCOLN, NEBRASKA

COST ANALYSIS

	<u>Night Assignment</u>	<u>Day Assignment</u>
A. Report 1 Name and Address Listing	\$ 40.00	\$ _____
B. Report 2 Assigned and Unassigned Blocks	200.00	139.00
C. Report 3 Shelter Assignments (Ample Warning)	75.00	55.00
D. Report 4 Shelter Assignments (One Hour Warning)	25.00	25.00
E. Report 5 Shelter Assignments (30 Minute Warning)	22.00	22.00
F. Report 6 Unassigned Blocks (Ample Warning)	20.00	20.00
G. Report 7 Unassigned Blocks (One Hour Warning)	20.00	20.00
H. Report 8 Unassigned Blocks (30 Minute Warning)	22.00	22.00
	<u>\$424.00</u>	<u>\$303.00</u>
Supplies: Cards & Paper	<u>26.00</u>	<u>26.00</u>
Night	\$450.00	\$329.00
Day	329.00	
Wiring two panel boards	<u>122.00</u>	
	<u>\$901.00</u>	

FIG. A-22 COST ANALYSIS

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